AP Chemistry Summer Assignment

The following questions correspond to chapters 1, 2, and 3 in the Zumdahl AP Chemistry 9th ed. textbook.

Chapter 1 – Chemical Foundations

Topics - Scientific Method, Units of Measurement, Accuracy vs. Precision, Significant Figures, Dimensional Analysis, Density, Classification of Matter

Significant Figures (Sig Figs)

Rules for counting sig figs:

Rules for rounding when performing mathematical operations:

1. How many sig figs are in the following numbers?

a) 0.0450_____

b) 790_____

c) 32.10_____

2. Solve the following problems. Round your answer to the correct number of sig figs (and use the correct unit on your answer).

a) 825 cm x 32 cm x 0.248 cm_____

b) 15.68 g / 2.885 mL_____

Density (round your answers to correct number of sig figs and show all work with units)

1. A cube of ruthenium metal 1.5 cm on a side has a mass of 42.0 g. What is the density in g/cm3? Will ruthenium metal float on water?

2. The density of bismuth metal is 9.8 g/cm3. What is the mass of a sample of bismuth that displaces 65.8 mL of water?

Metric Conversions (round your answers correctly and show work with units)

The prefixes you will need to have memorized are the ones from **kilo- to milli-**, and **micro-.**

Common Prefixes used with SI Units			
Prefix	Symbol	Meaning	Order of Magnitude
giga-	G	1 000 000 000	10^9
mega-	M	1 000 000	10^6
kilo-	k	1 000	10^3
hecto-	h	100	10^2
deka-	da	10	10^1
	base unit	1	10^0
deci-	d	0.1	10^{-1}
centi-	c	0.01	10^{-2}
milli-	m	0.001	10^{-3}
micro-	μ	0.000 001	10^{-6}
nano-	n	0.000 000 001	10^{-9}

Make the following conversions:

a) 16.2 m to km

b) 5.44 nL to mL

c) 25.3 mg into g

d) 745 nm into m

e) 4.89×10^7 m into nm

f) 45.7 mL/s to kL/hr

Dimensional Analysis

For any dimensional analysis problems you will have to do this year, you will be given the conversion factor. For the following problems, use the conversion factors on the right.

1. **908 oz to kilograms**
2. **12.8 L to gallons**
3. **2.89 gallons to mL**
4. **4.48 lb to grams**
5. **55 miles per hour to m/s**
6. **2.3 mi^2 to m^2**

Conversion Factors

Length:

12 inches (in) = 1 foot (ft)
3 feet = 1 yard (yd)
5280 feet = 1 mile (mi)

Weight:

16 ounces (oz) = 1 pound (lb)
2000 lb = 1 ton

Capacity:

3 teaspoons (tsp) = 1 tablespoon (tbsp)
16 tsp = 1 cup (c)
8 ounces (oz) = 1 c
2 c = 1 pint (pt)
2 pt = 1 quart (qt)
4 qt = 1 gallon (gal)

Metric to English	English to Metric
Length: 1 mm = 0.04 in 1 cm = 0.39 in 1 m = 39.37 in = 3.28 ft 1 m = 1.09 yd 1 km = 0.62 mi	**Length:** 1 in = 2.54 cm 1 ft = 30.48 cm = 0.305 m 1 yd = 0.914 m 1 mi = 1.609 km
Weight: 1 g = 0.035 oz 1 l = 1.057 qt	**Weight:** 1 oz = 28.350 g 1 lb = 0.453 kg
Capacity: 1 ml = .2 tsp 1 l = 1.057 qt	**Capacity:** 1 tsp = 5 ml 1 c = 236 ml 1 qt = 0.946 l 1 gal = 3.785 l

Precision and Accuracy

Definitions from Chapter 1:

Precision - _____

Accuracy - _____

Random Error - _____

Systematic Error - _____

A way to visualize the difference between accuracy and precision is to pretend you are throwing darts at a dartboard. Your objective is to hit the bullseye on the dartboard. Draw in 4 darts according to what each picture is asking.

Accurate and Precise

Precise but not accurate

Neither accurate nor precise

To check the accuracy of a graduated cylinder, a student filled the cylinder to the 25-mL mark using water delivered from a buret (see Fig. 1.6) and then read the volume delivered. Following are the results of five trials:

Trial	Volume Shown by Graduated Cylinder	Volume Shown by the Buret
1	25 mL	26.54 mL
2	25 mL	26.51 mL
3	25 mL	26.60 mL
4	25 mL	26.49 mL
5	25 mL	26.57 mL
Average	25 mL	26.54 mL

Is the graduated cylinder accurate?

Classification of Matter

Properties and Changes

Categorize each of the following as an element, a compound, or a mixture:

a. carbonated water _____
b. tungsten _____
c. aspirin (acetylsalicylic acid) _____
d. air _____
e. lye (sodium hydroxide) _____
f. fluorine _____

Iron pyrite, also known as fool's gold, has a shiny golden metallic appearance. Crystals are often in the form of perfect cubes. A cube of iron pyrite measuring 0.40 cm on each side has a mass of 0.064 g.

a. Which of these observations are qualitative and which are quantitative?

b. Which of these observations are **extensive** (dependent on the amount of substance present) and which are **intensive** (independent of the amount of substance present)?

Identify the following as a physical property, physical change, chemical property, or chemical change:

a. Ethanol has a density of 0.697 g/mL. _____
b. The solution turns blue upon mixing water and food coloring. _____
c. Wood burns in an oven. _____
d. Methyl alcohol is highly flammable. _____
e. Ice melts in a beaker. _____
f. Methyl ethanoate smells like apples. _____
g. Iron rusts on a car. _____
h. Alkali metals react strongly in hydrochloric acid. _____

<u>Types of separating mixtures</u>

Choices: Distillation, filtration, chromatography

This process uses differences in the volatility (how readily substances become gas) to separate the components. _____

This process is used to separate a mixture consisting of a solid and a liquid. _____

This method is used to separate multiple substances based on their relative affinities for a mobile phase and a stationary phase. _____

Chapter 2 – Atoms, Molecules, and Ions

Topics – Early History of Chemistry, Fundamental Chemical Laws, Daltons Atomic Theory, A/Z Symbol for Isotopes, Ions, Ionic naming

Dalton's Atomic Theory

1.
2.
3.
4.

Parts of the Periodic Table

You must be able to identify the following parts of the periodic table:

metals, nonmetals, groups, periods, alkali metals, alkaline earth metals, halogens, noble gases, transition metals, lanthanides, actinides, valence electrons and predicted charges based on groups

Atoms and A/Z Symbol for Isotopes

How many protons and neutrons are contained in the nucleus of each of the following atoms? How many electrons are present in each of these neutral atoms?

a. $^{13}_{6}C$ ____ protons ____ neutrons ____ electrons

b. $^{208}_{82}Pb$ ____ protons ____ neutrons ____ electrons

Complete the following table:

Name	Mass #	Atomic #	# of Protons	# of Neutrons	# of Electrons	Symbol
Gallium-70					31	
						$^{31}_{15}P^{-3}$
Strontium-80					36	
						$^{55}_{25}Mn^{+2}$

Average Atomic Mass

Magnesium consists of 3 naturally occurring isotopes with the masses 23.98504, 24.98584,and 25.98259 amu. The relative abundances of these three isotopes are 78.70%, 10.13 %, and 11.17% respectively. Calculate the average atomic mass.

Naming Ionic and Covalent Compounds

A list of polyatomic ions. You will be required to memorize the common polyatomic ions that we use regularly.

+1 ammonium, NH_4^+		
-1 acetate, $C_2H_3O_2^-$, or CH_3COO^- bromate, BrO_3^- chlorate, ClO_3^- chlorite, ClO_2^- cyanide, CN^- hydrogen carbonate, HCO_3^- (also called bicarbonate) hydroxide, OH^- hypochlorite, ClO^- iodate, IO_3^- nitrate, NO_3^- nitrite, NO_2^- permanganate, MnO_4^- perchlorate, ClO_4^- thiocyanate, SCN^-	-2 carbonate, CO_3^{-2} chromate, CrO_4^{-2} dichromate, $Cr_2O_7^{-2}$ oxalate, $C_2O_4^{-2}$ peroxide, O_2^{-2} sulfate, SO_4^{-2} sulfite, SO_3^{-2}	-3 phosphate, PO_4^{-3} phosphite, PO_3^{-3} arsenate, AsO_4^{-3}

Provide names for the following ionic compounds:

a. AlF_3

b. $Fe(OH)_2$

c. $Cu(NO_3)_2$

d. $Ba(ClO_4)_2$

e. Li_3PO_4

Write the chemical formulas for the following compounds:

a. Copper(I) oxide

b.Potassium peroxide

c.Iron(III) carbonate

d.Aluminum hydroxide

Give the name or chemical formula for each of the following molecular substances:

a. SF_6

b.XeO_3

c.Dinitrogen tetroxide

d.Potassium cyanide

Give the name or chemical formula for the following compounds:

a. Ammonium oxalate

b.Manganese (III) dichromate

c.$Ti(OH)_4$

d.$Ni(ClO_2)_3$

e.Dinitrogen pentoxide

f.Aluminum oxide

Chapter 3 – Stoichiometry

Topics – Counting by Weighing, The Mole, Molar Mass, Percent Composition, Empirical Formulas, Chemical Equations, Balancing Equations, Stoichiometric Equations, Limiting Reactants

Moles

Calculate the number of moles of the following: (SHOW WORK)

a) 42.8 g of KNO_3

b) 155.7 L of CO_2 at STP

c) 9.25×10^{26} molecules of $CaCl_2$

Percent Composition

a. Calculate the percent composition of $C_{12}H_{22}O_{11}$ (sugar). (Give Percent of each element.)Show all work.

Reactions

Balance the following and equations and tell what type of reaction it is (synthesis, decomposition, single replacement, double replacement, or combustion)

a)___ $KNO_3 \rightarrow$ ___ KNO_2 + ___ O_2 Type: _____

b)___ $AgNO_3$ + ___ $K_2SO_4 \rightarrow$ ___ Ag_2SO_4 + ___ KNO_3 Type: _____

c)___ CH_3NH_2 + ___ $O_2 \rightarrow$ ___ CO_2 + ___H_2O + ___ N_2 Type: _____

d)___ N_2O_5 + ___ $H_2O \rightarrow$ ___HNO_3 Type: _____

What are diatomic molecules? List the 7.

Translating Equations

Write balanced chemical equations for the following word equations.

Use the lowest possible whole-number coefficients to balance the equations.

a. Aqueous solutions of ammonium sulfate and barium nitrate form a precipitate of barium sulfate and aqueous ammonium nitrate.

b. Elemental magnesium and oxygen gas combine to form solid magnesium oxide.

c. Chlorine gas and aqueous potassium bromide react to form bromine liquid and aqueous potassium chloride.

d. Solid copper (II) carbonate decomposes to form crystals of copper (II) oxide and carbon dioxide gas.

e. Liquid benzene, C_6H_6, undergoes combustion in oxygen gas, making carbon dioxide gas and steam.

Stoichiometry

Using the following equation: $2\ NaOH + H_2SO_4 \rightarrow\ 2\ H_2O + Na_2SO_4$

How many grams of sodium sulfate will be formed if you start with 200 grams of sodium hydroxide and you have an excess of sulfuric acid?

Using the following equation: $Pb(SO_4)_2 + 4\ LiNO_3 \rightarrow\ Pb(NO_3)_4 + 2\ Li_2SO_4$

How many grams of lithium nitrate will be needed to make 250 grams of lithium sulfate, assuming that you have an adequate amount of lead (IV) sulfate to do the reaction?

Using the following equation: $Fe_2O_3 + 3\ H_2 \rightarrow 2\ Fe + 3\ H_2O$

Calculate how many grams of iron can be made from 16.5 grams of Fe_2O_3.

Limiting Reactant & Percent Yield

Determine the grams of sodium chloride produced when 10.0 g of sodium react with 10.0 g of chlorine gas according to the equation: $2\ Na + Cl_2 \rightarrow\ 2\ NaCl$

Determine the mass of lithium hydroxide produced when 50.0g of lithium are reacted with 45.0g of water according to the equation: $2\ Li + 2\ H_2O \rightarrow\ 2\ LiOH + H_2$

Determine the percent yield of water produced when 68.3 g of hydrogen reacts with 85.4g of oxygen and 86.4g of water are collected. $2\ H_2 + O_2 \rightarrow\ 2\ H_2O$