Belmont High School

AP Chemistry 2017 – 2018

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Course Introduction & Summer Assignment

Welcome to AP Chemistry. I have multiple goals for you in this course:

1. To be able to analyze and discuss scientific phenomena in a way that is “research-lab ready”.
2. To learn how fundamental chemical principles apply to diverse fields both within and beyond science.
3. To find joy and confidence in tackling challenging lines of analysis.
4. To develop your appreciation of the relationship between scientific concepts and the mathematic expressions of those concepts.
5. To maximize your chance of earning a “5” from 8:00 – 11:15 *Monday, May 7, 2018*.

You should come get a textbook from Room 225 during finals week or early the next week.

Summer Assignments

Assignment #1 Lab work	1. Complete the pre-lab for Lab 1-1 (includes lab book set-up). 2. Complete the bleach & food coloring experiment. Lab book & lab write-up (3-5 pages) due 1st day ***Lab report should be typed & handed in like a paper (only the raw data, procedure and observations go in the lab book).*** 3. Get your Lab Safety Contract signed (lab work usually begins day 2)
Assignment #2 Problem set	This will be collected and graded on the first day. Use the textbook or ask a peer if you have trouble.
Assignment #3 History of chemistry	Read The Alchemy of Air by Thomas Hager (2009). Available from local libraries and relatively cheap on Amazon. *Optional: Read The Making of the Atomic Bomb by Richard Rhodes (it is 900 pages long, but the first 300 or so are the history of chemistry & physics that are most interesting).*

Chapter 1: Matter & Measurement

Classification of matter (elements, compounds, mixtures); separation of mixtures
General sense of which elements are common in various contexts (Universe, Earth, living things)
Physical & chemical properties & changes
Unit conversions and precision of measurements (significant figures/digits)
Dimensional analysis

Chapter 2: Atoms, Molecules & Ions

Molecular interpretation of temperature (kinetic energy of particles)
Basic atomic structure: atomic number, mass number, charge, isotopes, atomic mass/weight
Getting the above information from the periodic table
Discovery of atomic structure (Dalton, Thomson, Rutherford, Millikan, Curie, Chadwick)
Constant composition of compounds & meaning of formulas
Ions & ionic compounds
Naming compounds: ionic, molecular, acids

Chapter 3: Stoichiometry

Writing, balancing, and interpreting meaning of balanced chemical equations
Moles & mole conversions (grams ↔ moles ↔ liters of gas at STP)
Empirical & molecular formulas
Limiting reactants & reaction yields

Chapter 4: Aqueous Reactions & Solution Stoichiometry

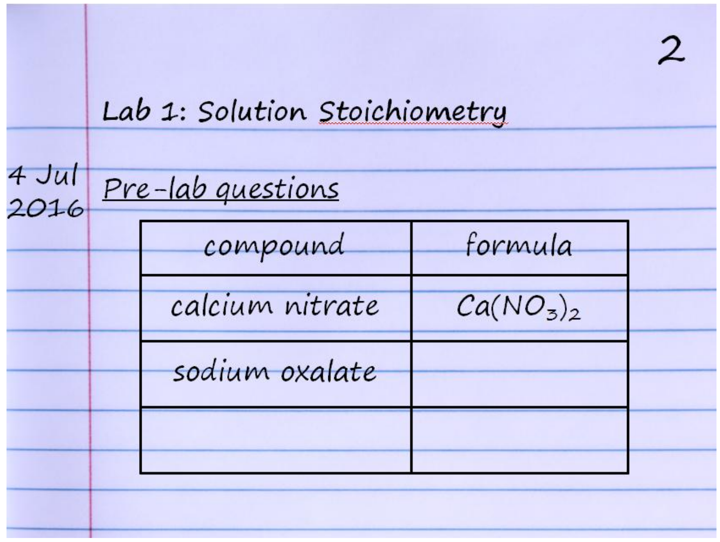
Nature of aqueous solutions (electrolytes, ionic vs. molecular solutes, strong vs. weak acids)
Types of reactions (precipitation, double displacement, acid-base, redox)
Solution concentration, making solutions, dilutions
Solution stoichiometry: titrations

LAB 1-1: Solution Stoichiometry

Pre-Lab

I. Get your lab notebook set up

1. Get a **standard-size composition book** to be your lab notebook. Quadrille (graph) ruled is preferable, but standard college or wide-ruled is acceptable.
2. Write only on ONE SIDE of the notebook sheets (whichever you prefer). Go through and number the pages in the upper right (or left) corner. Do NOT number pages you will NOT write on.
3. **Leave pages 1-3 blank.**
4. On page 4, write “Summer Experiment: Bleach & Food Coloring” and leave several pages for your observations.
5. <u>In the margin</u>, write the date. We will follow this convention throughout the year, as we frequently work on a single lab for multiple days. **Pages are not dated, the individual tasks are**.
6. Write “Lab 1: Solution Stoichiometry” as shown after the summer data. Complete the pre-lab questions on the page next to the date.



II. Pre-lab questions

In this exploration, we will be mixing 0.10 *M* solutions of calcium chloride and sodium oxalate in test tubes.

1. Do a quick search for “kidney stones” and read about them a bit. What precipitate to you expect to form?
2. Make a table that lists the formulas of the 4 possible combinations of the 4 ions (calcium, sodium, chloride, and oxalate) and the names of those compounds.
3. Write the following reactions for calcium chloride mixed with sodium oxalate.
   a. Complete reaction: $CaCl_2(aq)$ + …
   b. Complete ionic equation: $Ca^{2+}(aq) + 2\ Cl^{-}(aq)$ + …
   c. Net ionic equation (spectator ions omitted)
4. Qualitatively predict the amount of precipitate formed in each tube, ranking the tubes in order from most precipitate to least. If you expect any tubes to contain equal amounts of precipitate, indicate that.

tube #	**1**	**2**	**3**	**4**	**5**
0.10 *M* calcium chloride (mL)	1.0	3.0	5.0	7.0	9.0
0.10 *M* sodium oxalate (mL)	9.0	7.0	5.0	3.0	1.0

5. The **solubility product** (K_{sp}) of calcium oxalate is the equilibrium constant for the <u>reverse</u> of #3(c). Its value at 25°C is 2.7×10^{-9}.
   a. Write the equilibrium expression K_{sp} = …
   b. How many moles of calcium oxalate will remain dissolved in the 10.0 mL of solution in each tube if we assume that $[Ca^{2+}] = [C_2O_4^{2-}]$?
   c. Calculate what percent (b) is of the total moles added to show that the amount that remains dissolved is negligible.

Materials

0.10 *M* calcium chloride   0.10 *M* sodium oxalate   test tubes   volumetric pipets

Procedure

1. Line up 5 test tubes.
2. Using volumetric pipets, make the mixtures indicated in the pre-lab table. There is no order or time concern for this.
3. Let the solid settle for several minutes, then check to estimate quantity of precipitate.
4. Filter and weigh the precipitate from JUST ONE of your tubes (you will be told which by your teacher).

Analysis

1. Make a rough bar graph or sketch that shows the amount of precipitate in each tube.

2. Account for any differences using the term ***limiting reactant*** *(also called limiting* ***reagent****).*

3. Excluding K_{sp} considerations, <u>for whichever tube you dried and weighed the precipitate</u>

   (a) How many moles of Ca^{2+}(*aq*) were added?

   (b) How many moles of $C_2O_4^{2-}$(*aq*) were added?

   (c) What is the theoretical yield of precipitate in moles AND grams?

   (d) Determine the theoretical [Ca^{2+}], [Cl^{-}], [Na^{+}] and [$C_2O_4^{2-}$] in the 10.0 mL of solution at the end.

   (e) Based on the mass of calcium oxalate collected, determine the percent yield of the reaction.

4. If you inadvertently used 0.15 *M* $CaCl_2$, how would that have affected the amount of precipitate formed in each of the tubes?

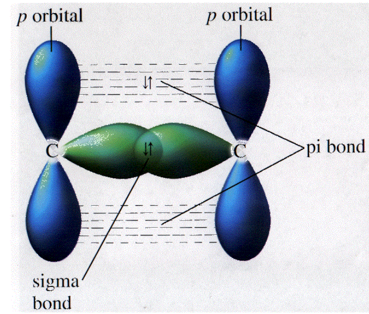
5. How would your results have been affected if you had put 6.0 mL of $CaCl_2$ into tube 4 instead of 7.0 mL?

Suppose you decided to do another experiment involving the same chemicals. In this experiment, however you use the numbers shown in the table as ***grams*** of solute dissolved in equal volumes of solution rather than milliliters of a 0.10 *M* solution.

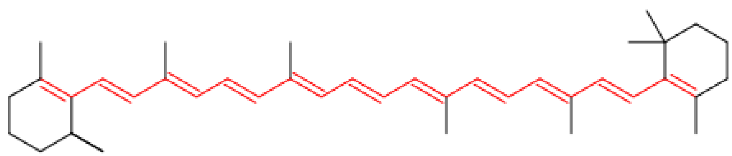
6. How will the results of this experiment differ from the results of your first experiment?

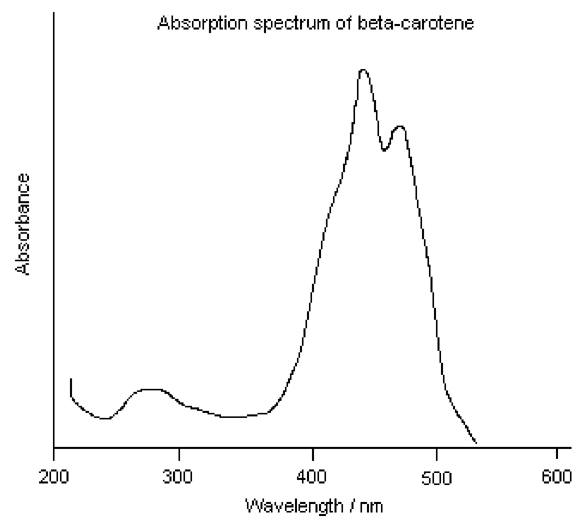
7. Which tube will contain the greatest number of moles of precipitate? How many moles will it contain?

AP Chemistry Summer Experiment 2017
How do various factors affect the rate at which chemical whiteners destroy organic color?



Introduction: When white light encounters matter, some wavelengths may be absorbed by electrons as they are promoted to higher energy states. The removal of specific wavelengths imparts color to reflected or transmitted light. There are basically 2 classes of material that can do this: transition metals and organic molecules. Transition metals have outer electrons in *d* orbitals, differences amongst which lie within the visible range (search Crystal Field Theory for more). The backbone of organic molecules is the carbon-carbon bond. When carbons bond to carbons, the first covalent bond results from the overlap of 2*s* orbitals, so it is called a sigma (σ) bond. When double or triple bonded, however, the 2nd and 3rd shared pairs are called pi (π) bonds, resulting from overlap of 2*p* orbitals, which lie above and below the bond axis (see diagram at left). When double and single bonds <u>alternate</u> in organic molecules, π-bonded electrons from the double bonds will be *delocalized* (conjugated) since they exist above and below the carbon chain. These electrons tend to absorb visible light. β-carotene, the orange molecule from carrots (shown), is a classic example. If you want to read more, search "conjugated system."





Materials

- Dixie cups (or other appropriate containers)
- household bleach
- food coloring (blue, green, red) or other brightly colored molecule (think juices)
- timer

Procedure

Design an experiment in which you adjust variables systematically (see below) and measure time until color disappears. You should always have a "blank" next to your trial for color comparison – when "all color is gone" is a judgment call. The variable(s) you adjust must be defined numerically so that you can produce a mathematic relationship between your variable and the time to completion. It is up to you to determine a consistent protocol: whether you will swirl, stir, do nothing, etc. The quality of your data set will reveal the care you put into this.

1. Adjust the **concentration** of whitener solution systematically – the more dilutions (trials) the better.
2. Adjust the **concentration** of colored molecules systematically. Note that you will probably also be changing the *amount* of colored molecules as well. <u>Careful about how you interpret the results</u>!
3. OPTIONAL: Vary temperature.

KEY POINTS TO CONSIDER

The time to completion is NOT a rate in and of itself. If the concentrations of reactants change appreciably during the trial, the rate is not constant, just as interest does not accrue at a constant rate in a bank account. For bleach, this is NOT a problem: unless you dilute it vastly or use large amounts of coloring, bleach is so concentrated that its concentration is essentially constant throughout each trial. The food coloring, however, *must* change its concentration throughout the trial, or else it will not go away!

It is OK to use “arbitrary units” for volumes and concentrations. We are looking for trends as we adjust variables. If you have a spoon or cup to measure volume, you do not need to know its real volume. Call it “1” and express all your volumes as multiples/fractions of it. Of course, if you use an actual teaspoon/tablespoon, etc. you are allowed to display true volume (in mL). Likewise, you do not need to know the actual molar concentration of the colored solutions or the whitener. Call the most (or least) concentrated one “1” and label all others as fractions (or multiples) of that.

Critical point to consider

When solutions are mixed, they both become diluted. You are going to react A(*aq*) with B(*aq*). Say in your first trial you add 10 mL of A to 10 mL of B. Then you say, “I want to double the concentration of B, so I will now do 10 mL of A with 20 mL of B.”

Hold it! First, you have changed [A] by diluting it into 30 mL instead of 20 mL total. Plus, you have NOT doubled [B] (increase of just 33%), and on top of that, you added ***twice as much*** B, which will certainly affect how long it takes to complete the reaction.

Adding variable amounts of water (which is not a reactant) is one strategy to adjust the concentration of one reactant while keeping all others constant. A table of mixtures (in arbitrary units) is given to demonstrate. This strategy is not necessarily required but it solves the critical issue described above.

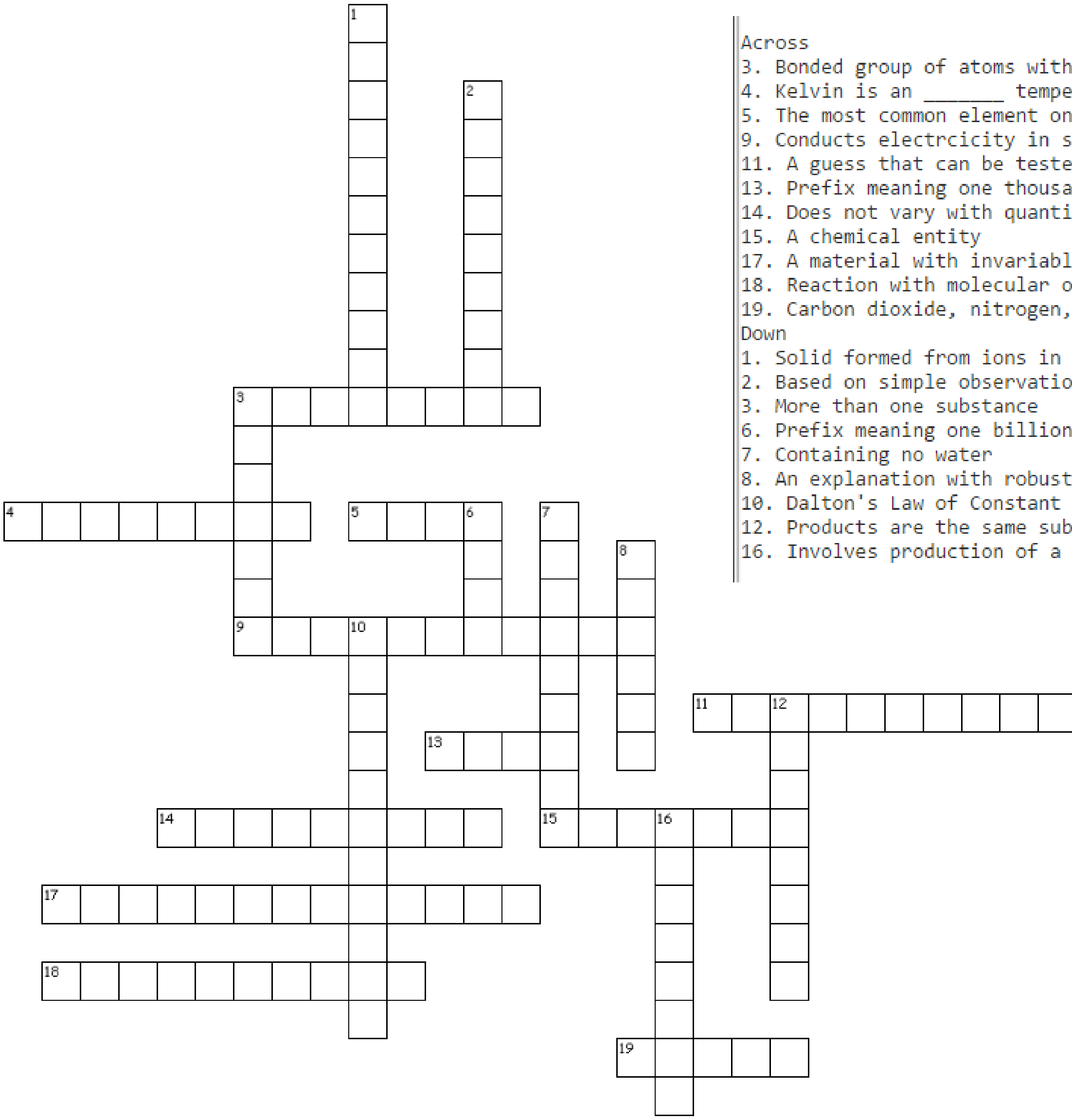
volume of A	volume of B	volume water	**total volume**	[A]	[B]
10	20	0	**30**	1	2
10	10	10	**30**	1	1
5	20	5	**30**	0.5	2

Analysis: <u>**how does(do) the variable(s) you investigated influence the rate of chemical reaction?**</u>
Analyze, present, and discuss your data to answer the question. Your answer will be specific and numerical and be supported carefully using your data as well as any researched information you wish to cite. Visual presentation is critical (graph or at least a table with a summary data). Your report should be 3- 5 pages and include the following sections.

1) **HEADING**
2) **TITLE**
3) **ABSTRACT**
   This is a paragraph describing three things: a brief description of your experiment and its context, a summary of your results (quantitative), and the key conclusions. It will generally be 3-6 dense, meaningful, carefully crafted sentences. Excellent sentence structure is needed to include key background, description of the experiment, and justification and explanation of claims with evidence.
4) **MATERIALS & METHODS**
   Be concise but specific; list, prose, flowchart all acceptable. First person OK.
5) **RESULTS**
   Organize data & observations into a data table. Frequently it is appropriate to add columns for some calculation you did with the raw data (e.g. average rate). **Create graphs** that display the data in a form that is easier to interpret – embed these in the discussion. Consider creating a table that summarizes results for use in the discussion.
6) **DISCUSSION**
   This is a summary of the experiment: what questions the data answer, and what questions they raise. The discussion is an essay about the experiment. Write it like any other essay: make an outline of your ideas. Trust your data to give you the answers, not what you thought before: EVIDENCE TRUMPS LOGIC. Justify your statements with observations. Embed graphics and/or tables to support your discussion.

AP Chemistry Name ________________________________ Date _______________

AP Chemistry Summer Fun



Across
3. Bonded group of atoms with no charge
4. Kelvin is an _______ temperature scale
5. The most common element on Earth
9. Conducts electrcicity in solution
11. A guess that can be tested
13. Prefix meaning one thousand
14. Does not vary with quantity
15. A chemical entity
17. A material with invariable composition
18. Reaction with molecular oxygen
19. Carbon dioxide, nitrogen, and oxygen at STP

Down
1. Solid formed from ions in solution
2. Based on simple observation
3. More than one substance
6. Prefix meaning one billionth
7. Containing no water
8. An explanation with robust evidence
10. Dalton's Law of Constant ________
12. Products are the same substances
16. Involves production of a new substance

1. Use the best metric prefix to write the following measurements without powers of 10. **(1.4)**
   (a) 6.35×10^{-2} L (b) 5.5×10^{9} Hz (c) 7.45×10^{-7} m

2. The density of platinum is 21.4 g cm^{-3}. How many moles of platinum are in a sphere of platinum with a diameter of 15.6 mm? **(1.4)**

3. Calculate and/or convert units to answer the following. **(1.5 & 1.6)**
   → **Show work and unit cancellation (dimensional analysis).**
   → **Report the answers rounded to the correct number of significant figures.**
   → **You should be able to do these with only a periodic table.**

(a) How many moles is 2.378 g of copper?

(b) How many *atoms* are in a 6.5-g sample of zinc(II) chloride?

(c) What is the volume of a rectangular block with dimensions 1.5 cm x 2.88 cm x 2.30 cm?

(d) What is the volume of 4.66 x 10^{23} nitrogen molecules at STP?

(e) The wavelength of a green laser is given as 535 nm. Give that in meters, using scientific notation.

(f) Air is 20.1% oxygen by volume. What mass of oxygen is in Room 225, which has a volume of 522 m^3? Do this at 18°C and 1.0 atm rather than STP.

(g) In a car tire, the pressure is typically 35 psi $\left(\frac{\text{lb}}{\text{in}^2}\right)$. Convert to $\frac{\text{N}}{\text{ft}^2}$. **1 lb = 4.45 N (newtons), 1 in = 2.54 cm**

(h) The average energy received at Earth's surface is 342 $\frac{\text{W}}{\text{m}^2}$. This incorporates the day/night cycle. A watt (W) is 1 $\frac{\text{J}}{\text{s}}$. If we cover 1.0 mi^2 with 23% efficient solar panels, how many kWh of electricity can we produce in a year? Each U.S. citizen uses 14,000 kWh per year. How many people can the large solar array support?

4. ***1.58, p.34***
A sample of ascorbic acid (vitamin C) is synthesized in the laboratory. It contains 1.50 g of carbon and 2.00 g of oxygen. Another sample of vitamin C contains 6.35 g of C. How many grams of oxygen must it contain? Which law are you assuming in answering this question?

5. ***adapted from 1.65, p.34***
   - In the United States, water used for irrigation is measured in acre-feet.
   - An acre-foot of water covers an acre of area to a depth of 1 foot.
   - The world standard for agricultural area is the hectare, which is a square 100 m on a side.
   - There are 2.47 acres in a hectare.
   - 1 m^3 = 1000 L

   How many liters are in an acre-foot? (Yes you can type this into Google, but you must show work that relies only on the information given here!)

6. ***2.29, p. 72***
   (a) What isotope is used as the standard in establishing the atomic mass scale?

   (b) The atomic mass of boron is reported as 10.81, yet no atom of boron has a mass of 10.81 amu. Explain.

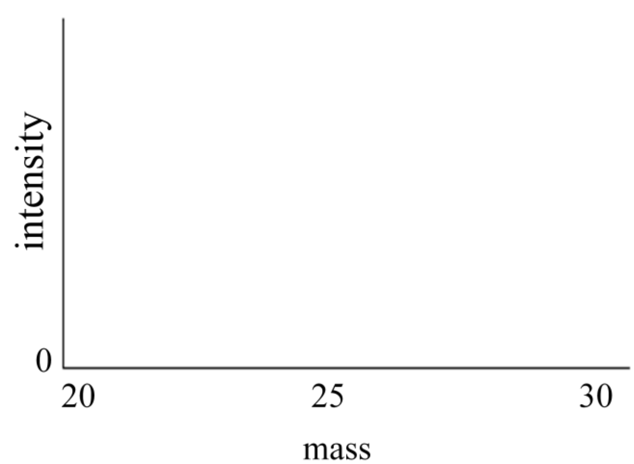
7. ***2.35, p. 72***
   Naturally occurring magnesium has the isotopic abundances given in the table.

mass of isotope	abundance
23.985	78.99%
24.986	10.00%
25.983	11.01%

   (a) Identify the isotopes of magnesium using the ${}^{Z}_{A}X$ format (e.g. ${}^{23}_{11}Na$ for the most common isotope of sodium).

   (b) Calculate the atomic mass of Mg and confirm with the periodic table.

   (c) Sketch the mass spectrum of Mg (mass number vs. intensity of signal).



8. **2.83, p.75**

An alpha (α) particle is the nucleus of a ^{4}He atom.

(a) How many protons and neutrons are in an α particle?

(b) What force holds the protons and neutrons together in an α particle?

(c) What is the charge on an α particle in coulombs?

(d) The charge-to-mass ratio of an α particle is 4.8224×10^{4} C g^{-1}. Based on the charge of the particle, calculate its mass in grams and amu.

(e) By using the data in Table 2.1, compare your answer for part (d) with the sum of the masses of the individual subatomic particles. Explain any difference in mass.

9. From the choices on the right, select the one that could represent

(a) pure nitrogen gas _________

(b) helium gas ___________

(c) solid iron ____________

(d) solid compound X_2Y _________

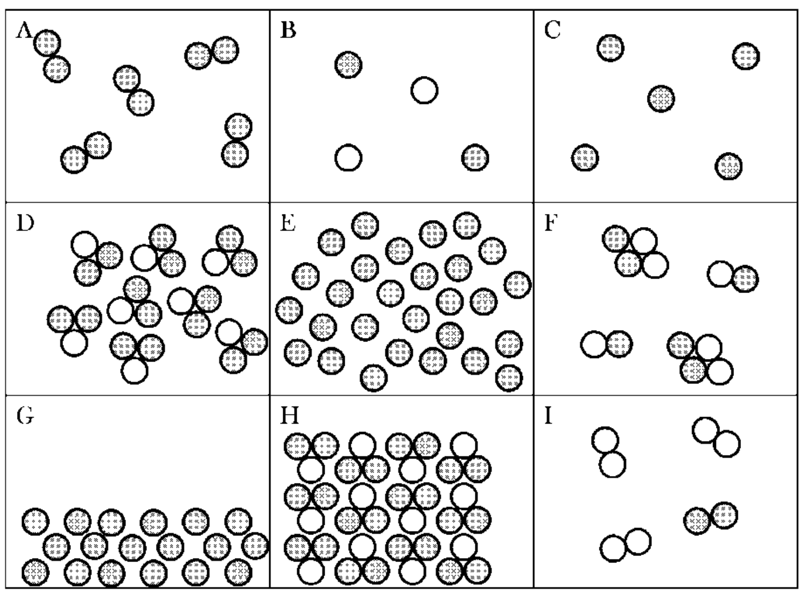
(e) liquid X_2Y ___________

(f) air _______________

(g) liquid copper _____________

(h) a mixture of elements _____________

(i) a mixture of compounds ___________



10. Complete the following table.

element	***symbol (X)***	***# protons (Z)***	***# neutrons***	***# electrons***	***mass number (A)***	***charge***	$^{A}_{Z}X$
		24			52	3+	
strontium			49			2+	
	Mn			21	55		
		7	7			0	
				6			$^{14}_{6}C$
potassium			21			1+	
						0	$^{197}_{79}Au$
	Ar			18	40		

11. Balance the following chemical reactions. They increase in level of difficulty.
Note that <u>charge</u> must be balanced as well as numbers of atoms.

(a) $C_4H_{10}(g)$ + $O_2(g)$ → $CO_2(g)$ + $H_2O(g)$

(b) $CuO(s)$ + $NH_3(g)$→ $N_2(g)$ + $H_2O(g)$ + $Cu(s)$

(c) $FeS_2(s)$ + $O_2(g)$ → $Fe_2O_3(s)$ + $SO_2(g)$

(d) $Cu(s)$ + $HNO_3(aq)$ → $Cu(NO_3)_2(aq)$ + $NO_2(g)$ + $H_2O(l)$

(e) $Fe^{2+}(aq)$ + $Cl_2(aq)$ → $Fe^{3+}(aq)$ + $Cl^{-}(aq)$

(f) $Cu(s)$ + $HNO_3(aq)$ → $Cu(NO_3)_2(aq)$ + $NO(g)$ + $H_2O(l)$

12. First, name each material. Then write whether it is ionic, molecular, metallic, or covalent network.

(a) NaCl *sodium chloride - ionic*

(b) $Pb(NO_3)_2$

(c) CH_4

(d) $Ca(OH)_2$

(e) SiO_2

(f) CH_3OH

(g) $MgBr_2$

(h) Cu

(i) CH_3COOH

(j) NH_3

13. Write and balance equations for the following reactions. INCLUDE STATES, FOLLOWING THE EXAMPLE

SOLUBILITY RULES at 25° C *given in order of precedence*

1. Nitrate salts are soluble.
2. Sodium, potassium, and ammonium salts are soluble.
3. Chloride salts are soluble. *exceptions*: AgCl, $PbCl_2$, Hg_2Cl_2
4. Sulfate salts are soluble. *exceptions*: $BaSO_4$, $PbSO_4$, $CaSO_4$
5. Hydroxide salts are **in**soluble.
6. Sulfide, oxide, carbonate & phosphate salts are **in**soluble.

(example) potassium sulfide solution is mixed with iron(III) chloride solution

full: $3\ K_2S(aq) + 2\ FeCl_3(aq) \rightarrow Fe_2S_3(s) + 6\ KCl(aq)$

ionic: $6\ K^+(aq) + 3\ S^{2-}(aq) + 2\ Fe^{3+}(aq) + 6\ Cl^-(aq) \rightarrow Fe_2S_3(s) + 6\ K^+(aq) + 6\ Cl^-(aq)$

net ionic: $3\ S^{2-}(aq) + 2\ Fe^{3+}(aq) \rightarrow Fe_2S_3(s)$

(a) A precipitate forms when calcium chloride solution is mixed with silver(I) nitrate solution
write full, ionic, and net ionic: follow the example above

(b) Propane (C_3H_8) combusts completely.

(c) In an acid-base reaction, baking soda (sodium bicarbonate) reacts with vinegar (acetic acid) to produce carbon dioxide amongst other products.

(d) Copper metal forms when a piece of zinc is placed in a solution of copper(II) nitrate.

14. ***3.38, p. 112***

The molecular formula of aspartame, the artificial sweetener marketed as NutraSweet, is $C_{14}H_{18}N_2O_5$.

(a) What is the molar mass of aspartame?

(b) How many moles of aspartame are present in 1.00 mg of aspartame?

(c) How many molecules of aspartame are present in 1.00 mg of aspartame?

(d) How many hydrogen atoms are in 1.00 mg of aspartame?

15. ***p. 112, 3.50b***

Determine the empirical and molecular formulas of cadaverine, a foul-smelling substance produced by the action of bacteria on meat. It contains 58.55% C, 13.81 % H and 27.40% N bay mass. 128.5 mL of cadaverine gas at STP has a mass of 586 mg.

16. ***p. 115, 3.88***

Vanillin, the dominant flavoring in vanilla, contains C, H, and O. When 1.05 g of this substance is completely combusted, 2.43 g of CO_2 and 0.50 g of H_2O are produced. What is the empirical formula of vanillin?

17. Fill in the missing formula or name. Follow the examples. **Ultimately you need to be able to do this with only a periodic table. (2.5 to 2.8)**

formula	name	formula	name
$Co_2(SO_4)_3$	cobalt(III) sulfate	N_2O	dinitrogen monoxide
$SrCl_2 \cdot 6\ H_2O$	strontium chloride hexahydrate	H_2CO_3	carbonic acid
$Ca(OH)_2$			hydrochloric acid
		SO_2	
	manganese(II) chloride		strontium peroxide
$CuSO_4 \cdot 5\ H_2O$			methane
		Ag_2O	
$Cr(IO_3)_3$		H_2SO_4	
H_3PO_4			sulfur hexafluoride
	magnesium sulfite	$Zn(HCO_3)_2$	
BrF_5			nitric acid
$Fe_2(CO_3)_3$			tin(IV) nitrate
C_3H_8			ammonium chloride
	ammonia	C_2H_5OH	

18. ***adapted from 3.74 (p. 114)***

One of the steps in the commercial process for converting ammonia to nitric acid is the conversion of ammonia to nitrogen monoxide:

$$4\ NH_3(g) + 5\ O_2(g) \rightarrow 4\ NO(g) + 6\ H_2O(g)$$

In a certain experiment, 1.50 g of NH_3 reacts with 2.75 g of O_2.

a) Which is the limiting reactant?

b) How many grams of NO and H_2O do you expect to form?

c) How many grams of the excess reactant remain after the limiting reactant is completely consumed?

d) Show that your calculations in parts (b) & (c) are consistent with the law of conservation of mass.

19. ***3.97, p.116***

A mixture of $N_2(g)$ and $H_2(g)$ reacts in a closed container to form ammonia, $NH_3(g)$. The reaction ceases before either reactant has been totally consumed. At this stage, 3.0 mol of each substance is present. How many moles of N_2 and H_2 were present originally? Show your thinking.

20. ***3.5, p.109***

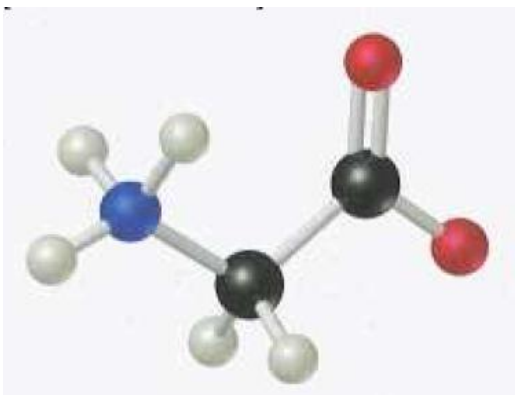
Glycine, an amino acid used by organisms to make proteins, is represented by the molecular model shown.

(a) Write its molecular formula.

(b) Determine its molar mass.

(c) Calculate the mass of 3.0 moles of glycine.

(d) Calculate the percent nitrogen by mass in glycine.



21. Suppose that a student dissolves 3.56 g of pure Na_2SO_4 in 125 mL of solution.
(a) Calculate the molarity of sodium sulfate in the solution.

(b) What are $[Na^+]$ and $[SO_4^{2-}]$ in the solution?

(c) To what volume does this solution needed to be diluted to achieve a concentration of 0.0500 *M*?

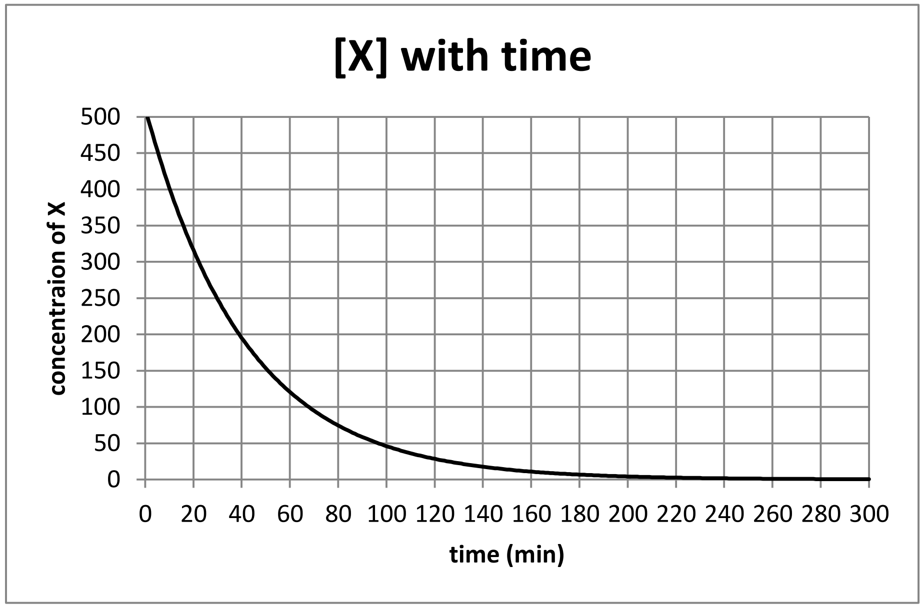
22. ***4.64, p.159***
A person suffering from hyponatremia has a sodium ion concentration of 0.118 *M* and a total blood volume of 4.6 L. What mass of sodium chloride would need to be added to the blood to bring the sodium ion up to a concentration of 0.138 *M*, assuming no change in blood volume?

23. Complete the following nuclear reactions using symbols and give the name of the process.

	Reaction	**name of process**
(a)	${}^{14}_{6}C \rightarrow \boxed{{}^{14}_{7}N} + {}^{-1}_{0}e$	$\boxed{\text{beta decay}}$
(b)	$\boxed{} \rightarrow {}^{206}_{82}Pb + {}^{4}_{2}He$	$\boxed{}$
(c)	${}^{2}_{1}H + {}^{3}_{1}H \rightarrow \boxed{} + {}^{1}_{0}n$	nuclear fusion
(d)	${}^{235}_{92}U + {}^{1}_{0}n \rightarrow \boxed{} + {}^{143}_{54}Xe + 3\,{}^{1}_{0}n$	$\boxed{}$

24. The half-life of carbon-14 is 5370 years. How much time has passed if a sample contains 12.5% of its original amount of ^{14}C?

25. What is the half-life of X? **On the graph, mark each half-life and confirm that [X] has halved in that time.**



$$2\ NO\ (g) \quad + \quad O_2(g) \quad \rightleftharpoons \quad 2\ NO_2(g) \qquad \Delta H° = -114\text{ kJ} \qquad K = 1.0 \times 10^{20}$$

26. Consider the equilibrium described by the chemical equation above.
    (a) Write the equilibrium expression. Are products or reactants favored at equilibrium?
    (b) Is the forward reaction exothermic or endothermic?
    (c) If P_{NO2} = 12.8 atm, P_{NO} = 0.0023 atm, and P_{O2} = 0.0068 atm, will the system shift left, right, or is it already at equilibrium?
    (d) Which way will equilibrium shift if…
        (i) P_{O2} is increased?
        (ii) T is lowered?
        (iii) Argon is added, raising the total pressure?

27. Rank the following materials in order of increasing conductivity (i.e. put the best conductor last).
see section 4.1 (starts on p. 120) for help

Cu(*s*)	1.0 *M* H_2CO_3(*aq*)	0.10 *M* HCl(*aq*)	1.0 *M* NaCl(*aq*)	1.0 *M* HF(*aq*)
1.0 *M* $CaCl_2$(*aq*)	NaCl(*l*)	1.0 *M* C_2H_5OH(*aq*)	0.10 *M* K_3PO_4 (*aq*)	H_2O(*l*)

28. At the same concentration, HCl solution conducts electricity equally as well as NaCl, but much better than HF solution. Place 10 of each in the containers of water below and show what becomes of them. Use the diagrams explain the difference in conductivity.

HCl(*aq*)	NaCl(*aq*)	HF(*aq*)

Safety Rules and Student Safety Contract

Belmont High School Science Department

Science and Technology classes involve a hands-on laboratory component. Many laboratory activities will be completed which require the use of potentially hazardous materials and/or tools. Safety in the science or technology laboratory is the main priority for students, teachers, and parents. The following rules must be followed at all times to ensure a safe laboratory environment.

Conduct in the Lab

1. Conduct yourself in a responsible manner at all times in the laboratory.
2. A laboratory is intended for serious, careful study. Horseplay, practical jokes, and pranks are dangerous and prohibited. Do not wander around the room, distract other students or interfere with the lab experiment of others.
3. Carefully follow all instructions, both written and oral. If you do not understand direction or a part of a procedure, ask the instructor before proceeding.
4. Unauthorized experiments are prohibited. Perform only those experiments authorized by the instructor.
5. Be alert and proceed with caution at all times in the laboratory. Do not touch any equipment, chemicals, or other materials in the laboratory area until you are instructed to do so.
6. Students may not work in the laboratory without an instructor present.
7. Experiments must be personally monitored by students during the class period.
8. Students are not permitted in the science storage rooms or in preparation areas unless accompanied by an instructor.
9. Eating food, drinking beverages or chewing gum during a lab activity is prohibited. Do not use laboratory glassware as containers for food or beverages.
10. Be prepared for your work in the laboratory. Read all procedures thoroughly before entering the laboratory.
11. All chemicals in the laboratory are to be considered dangerous. Do not touch, taste, or smell any chemicals unless specifically instructed to do so. The proper technique for smelling chemical fumes will be demonstrated to you.

Clothing

12. Safety goggles are provided to protect you from possible injury. Wear safety goggles when you are in a situation where a potentially dangerous substance might get into your eyes, such as when working with chemicals, heat, burners, glassware, or machinery.
13. The Belmont High School Science Department does not recommend the use of contact lenses or open-toed footwear during lab activities.
14. Dress properly during a laboratory activity. Long hair must be tied back and dangling jewelry and loose or baggy clothing must be secured.
15. Lab aprons have been provided for your use and may be worn during laboratory activities when required by your teacher or desired to protect clothing.

Lab Set-Up and Clean-Up

16. Know the locations and operating procedures of all safety equipment including the first aid kit, eyewash station, safety shower, fire extinguisher, and fire blanket. Be sure you know how to use this equipment. Know where the emergency exits are located.
17. Always work in a well-ventilated area. Use the fume hood when working with volatile substances or poisonous vapors. Never place your head into the fume hood.
18. Leave extra clothing and your books at your classroom desk. Keep aisles clear. Store backpacks, coats, etc. in an appropriate place.
19. Observe good housekeeping practices. Clean up all lab tools, materials, and surfaces as instructed by your teacher. Return all equipment clean and in working order to the proper storage area.
20. Wash your hands with soap and water after performing all lab exercises.

Handling of Chemicals and Biological Materials

21. Keep hands away from the face, eyes, mouth and body while using chemicals or preserved specimens.
22. Check the label on chemical bottles before removing any of the contents. Take only as much chemical as you need.
23. Dispose of all chemical waste properly. Never mix chemicals in sink drains. Sinks are to be used only for water and those solutions designated by the instructor. Solid chemicals, metals, matches, filter paper, and all other insoluble materials are to be disposed of in the proper waste containers, not in the sink.
24. Dispose of broken glass in the designated broken glass container.
25. Always use a rubber bulb or pump (never your mouth) when pipetting.
26. Handle all living organisms used in a laboratory activity in a humane manner. Preserved biological materials are to be treated with respect and disposed of properly according to teacher directions.

In Case of Accident

27. Notify the instructor immediately of accidents or of any unsafe conditions you observe.
28. If a chemical should splash in your eye(s) or on your skin, immediately flush with running water from the eyewash station or safety shower for at least 20 minutes. Notify the instructor immediately.
29. Report any accident (spill, breakage, etc.) or injury (cut, burn, etc.) to the instructor immediately, no matter how trivial it may appear.

Name of course: ________**AP Chemistry**__________

I have reviewed and understand these safety rules and agree to abide by them:

Student ________________________________ ________________________________ ______________

print *sign* *date*

I have reviewed these safety rules and I authorize the student named above to work with potentially hazardous chemicals and equipment at the discretion of the instructor.

Parent/guardian________________________________ ________________________________ ______________

print *sign* *date*