

AP Chemistry Summer Assignment

Welcome to AP Chemistry! In order to effectively cover all the material in this course, we will have to move quickly through the topics that you are already familiar with from Honors Chemistry. Therefore, you are expected to review the material listed below on your own over the summer. The material is covered in the first three chapters of your AP textbook (Chemistry, The Molecular Nature of Matter and Change, Silberberg 7e). Practice problems (with answers) have been included below to help you. Although these practice problems will not be collected, **you can expect a graded primary assessment with similar problems on the third class meeting of the school year**. Therefore, you should complete this assignment thoroughly, preferably in August so that the material is fresh when we begin in September.

If you run into trouble, or have any questions about the course, you can email lstafford@eccrsd.us or spatton@eccrsd.us. (We will be checking our emails periodically, but not daily.) Good luck and enjoy your summer - we look forward to meeting you in the fall!

Objective Checklist (with relevant chapters):

- Use the unit Factor Method (Dimensional Analysis) to convert from one quantity to another (1.4)
- Report answers with correct units (1.4)
- Report answers to the correct number of significant figures (1.5)
- Distinguish between accuracy and precision (1.5)
- Describe and explain early atomic experiments (2.1 - 2.4)
- Describe the structure of the atom (2.5)
- Know charges, formulas, and names of common monatomic and polyatomic ions (**These must be memorized!** Refer to tables 2.3, 2.4, and 2.5 on pages 66-68).
- Name and write formulas (2.8) for...
 - Binary ionic compounds
 - Ionic compounds containing polyatomic ions
 - Hydrated ionic compounds
 - Acids
 - Binary covalent compounds
- Convert between moles, mass, and number of particles (3.1)
- Determine the formula of an unknown compound (3.2)
- Write and balance chemical equations (3.3)
- Use stoichiometry to calculate quantities of reactant and product (3.4)

Part I: Refer to "Chapter 1: Keys to the Study of Chemistry" to solve the following problems.

Show all work, using the factor label method (dimensional analysis)! Be sure to include units in your answers. Report all answers to the correct number of significant figures.

1. What is the length, in inches, of a 100. m soccer field, given that 1 in = 2.54 cm?
2. The average radius of a molecule of lysozyme, an enzyme in tears, is 1430 pm. What is its radius in nanometers (nm)?
3. The radius of a barium atom is 2.22×10^{-10} m. What is its radius in angstroms (\AA)? (Note: 10^{-12} m = 1 pm; 100 pm = 1 \AA)
4. The center on your school's basketball team is 6 ft 10 in tall. How tall is the player in millimeters (mm)? (Note: 1 cm = 10 mm; 1 in = 2.54 cm; 12 in = 1 ft)
5. The speed of light in a vacuum is 2.9983×10^8 m/s. What is its speed in...
 - a. km/h?
 - b. mi/min? (Note: 1 km = 0.62 mi)
6. A small hole in the wing of a space shuttle requires a 20.7 cm² patch.
 - a. What is the patch's area in square kilometers (km²)?
 - b. If the patching material costs NASA \$3.25/in², what is the cost of the patch?
7. The area of a telescope lens is 7903 mm². (Note: 2.54 cm = 1 in and 12 in = 1 ft).
 - a. What is the area in square feet (ft²)?
 - b. If it takes a technician 45 s to polish 135 mm², how long does it take her to polish the entire lens?

8. The volume of a certain bacterial cell is $2.56 \text{ } \mu\text{m}^3$. (Note: $1 \text{ mL} = 1 \text{ cm}^3$)
- What is its volume in cubic millimeters (mm^3)?
 - What is the volume of 10^5 cells in L?
9. Answer the following, given that $1 \text{ quart} = 946.4 \text{ mL}$, $1 \text{ gallon} = 4 \text{ quarts}$, and $1 \text{ mL} = 1 \text{ cm}^3$.
- How many cubic meters of milk are in 1 qt?
 - How many liters of milk are in 835 gal?
10. Perform the following conversions:
- 68°F (a pleasant spring day) to $^\circ\text{C}$ and K
 - -164°C (the boiling point of methane, the main component of natural gas) to K and $^\circ\text{F}$
 - 0 K (absolute zero, theoretically the coldest possible temperature) to $^\circ\text{C}$ and $^\circ\text{F}$
 - $6.1 \times 10^3 \text{ K}$ (the surface temperature of the Sun) to $^\circ\text{F}$ and $^\circ\text{C}$
11. Round off each number to the indicated number of significant figures.
- 0.0003554 (to 2 sf)
 - 35.8348 (to 4 sf)
 - 22.4555 (to 3 sf)
 - 231.554 (to 4 sf)
 - 144,000 (to 2 sf)
12. Carry out the following calculations, and record your answer with the correct number of significant figures.
- $1.110 \text{ cm} + 17.3 \text{ cm} + 108.2 \text{ cm} + 316 \text{ cm}$
 - $\frac{2.420 \text{ g} + 15.6 \text{ g}}{4.8 \text{ g}}$
 - $\frac{7.87 \text{ mL}}{16.1 \text{ mL} - 8.44 \text{ mL}}$
 - $V = \pi r^2 h$, where $r = 6.23 \text{ cm}$ and $h = 4.630 \text{ cm}$
13. Which statements include exact numbers?
- Angel Falls is 3212 ft high.
 - There are 8 known planets in the Solar System.
 - There are 453.59 g in 1 lb.
 - There are 1000 mm in 1 m.

Answers: 1) $3.94 \times 10^4 \text{ in}$ 2) 1.43 nm 3) $2.22 \text{ } \text{Å}$ 4) $2.1 \times 10^3 \text{ mm}$ 5a) $1.079 \times 10^9 \text{ km/h}$ 5b) $1.1 \times 10^7 \text{ mi/min}$ 6a) $2.07 \times 10^9 \text{ km}^2$ 6b) $\$10.43$ 7a) $8.507 \times 10^{-2} \text{ ft}^2$ 7b) $2.6 \times 10^3 \text{ s}$ 8a) $2.56 \times 10^{-9} \text{ mm}^3$ 8b) 10^{-10} L 9a) $9.464 \times 10^{-4} \text{ m}^3$ 9b) $3.16 \times 10^3 \text{ L}$ 10a) $20.^\circ\text{C}$, 293 K 10b) 109 K ; $-263 \text{ }^\circ\text{F}$ 10c) -273°C ; -460°F 10d) $5.8 \times 10^3 \text{ }^\circ\text{C}$; $1.1 \times 10^4 \text{ }^\circ\text{F}$ 11a) 0.00036 11b) 35.83 11c) 22.5 11d) 231.6 11e) 140,000 12a) 443 cm 12b) 3.8 g 12c) 1.0 mL 12d) 565 cm^3 13) a, d

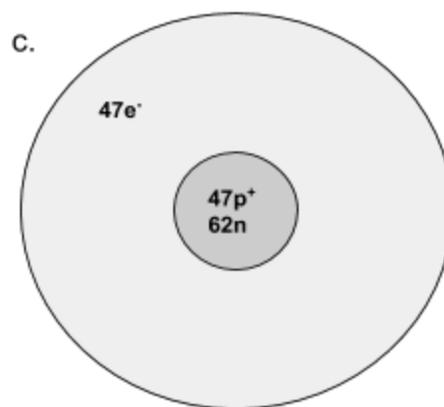
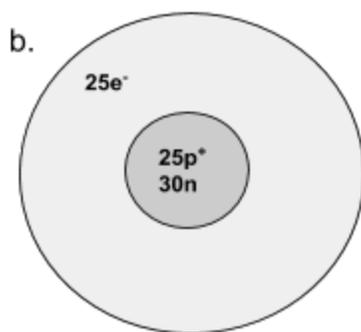
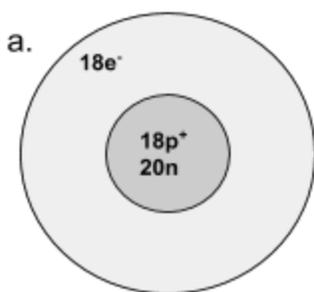
Part II: Refer to "Chapter 2: The Components of Matter" to solve the following problems.

- Which component of Dalton's atomic theory reflects his understanding of the law of conservation of mass for chemical processes? Why?
- Describe the "plum pudding" model of the atom. On which experiment/reasoning was it based?
- Describe Rutherford's "Gold Foil Experiment"? What conclusions were made from the results? How did this experiment change the atomic model?

4. Complete the table below for the following neutral atoms.

Name	# of Protons	# of Neutrons	# of Electrons	Atomic number (Z)	Mass number (A)	Nuclide Symbol
	26	30				
						$^{35}_{17}\text{Cl}$
	17				37	
Iodine-127						
	16	17				

5. Write the nuclide symbol (^A_ZX notation) for each of the following.



6. Draw atomic representations similar to those in the previous problem for
- ^{48}Ti
 - ^{79}Se
 - ^{11}B

7. Atom "A" has 11 neutrons and Atom "B" also has 11 neutrons. Are these atoms isotopes? Explain.

8. The atomic masses of elements are generally not whole numbers. Explain why.

9. Naturally occurring chlorine is 75.78% Cl - 35 (34.9689 amu) and 24.22% Cl - 37 (36.9659 amu). Calculate the average atomic mass.

10. An element is found to gain three electrons when it forms an ion.
 - a. What group number would this element be found in?

 - b. Is there enough information provided to determine what period it is in? Explain.

11. Look at the average atomic mass of Ar and K.
 - a. Explain why early scientists might have been tempted to have K follow Cl on the periodic table.

 - b. Propose two reasons as to why they placed Ar after Cl instead of K

12. Identify the following elements:
 - a. An alkali metal in the 5th period.
 - b. A transition metal in period 4
 - c. An atom in the 3rd period that forms a stable ion with a -1 charge.

13. Explain why atoms tend to gain or lose electrons relative to the number of valence electrons. How can you predict the number of electrons lost or gained?

14. Classify each element as metal, nonmetal, or metalloid. What ions would each element be likely to form?
 - a. Nitrogen
 - b. Calcium
 - c. Sulfur
 - d. Carbon

15. How many total ions (cations and anions) are present in the following ionic compounds?
 - a. sodium acetate
 - b. aluminum nitrate.
 - c. Copper(II) chloride

16. Aluminum reacts with a certain nonmetallic element to form a compound with the general formula Al_2X_3 . Element X must be from which group on the periodic table?

17. Complete the table on the next page. (No answer key - these can be easily checked online.)

	Chemical Formula	Chemical Name	Type of compound
1	NaI	Sodium iodide	Binary Ionic
2	KNO ₂		
3	(NH ₄) ₂ SO ₃		
4	CuSO ₄ •5H ₂ O		Hydrated ionic
5	AuNO ₂		
6	Al ₂ (CrO ₄) ₃		Ionic containing polyatomic ions
7	IF ₇		Binary covalent
8	Cu(OH) ₂		
9	NO		
10	H ₂ SO ₄		
11	CuI ₂		
12	HIO ₂		Acid
13		Manganese II sulfide	
14		Potassium peroxide	
15		Lithium permanganate	
16		Mercury (I) chloride	
17		Aluminum cyanide	
18		Manganese (II) nitride	
19		Ammonium sulfide	
20		Diphosphorus pentoxide	
21		Barium hydroxide octahydrate	
22		Sodium acetate	
23		Aluminum nitrate	
24		Copper (II) chloride	
25		Iron (III) Carbonate	

Answers: 1) postulate 1 - see p. 47 2) see p. 50 3) see p. 51 4) iron-56, 26e⁻, Z=26, A=56; chlorine-35, 17p⁺, 18n, 17e⁻, Z=17, A=35; chlorine-37, 20n, 17e⁻, Z=17, A=37; 53p⁺, 74n, 53e⁻, Z=53, A=74 5a) Z=18 and A=38, Ar 5b) Z=25 and A=55, Mn 5c) Z=47 and A=109, Ag 6a) 22p⁺, 26n, 22e⁻ 6b) 34p⁺, 45n, 34e⁻ 6c) 5p⁺, 6n, 5e⁻ 7) No. Isotopes have same Z (# of protons), but different A (# of protons+neutrons). 8) Weighted average of all isotopes 9) 35.45 amu 10a) group 15 10b) No 11a) K has a greater average atomic mass than Ar 11b) Ar behaves like other group 18 elements 12a) Rb 12b) Any element Z= 21 to 30 12c) Cl 13) metals gain nonmetals lose to get the same # of e^s as the nearest noble gas 14a) nonmetal, -3 14b) metal, 2+ 14c) nonmetal 2- 14d) metalloid 4+ or 4- 15a) 2 15b) 4 15c) 3 16) group 16

Part III: Refer to "Chapter 3: Stoichiometry of Formulas and Equations" to solve the following problems.

Show all work, using the factor label method (dimensional analysis)! Be sure to include units in your answers. Report all answers to the correct number of significant figures.

1. Answer the following questions for the compound aluminum sulfate.
 - a. What is the molar mass of this compound?

 - b. What is the mass of a 1.5 mole sample?

 - c. How many oxygen atoms are present in the 1.5 mol sample?

2. Consider a 0.433 mol sample of calcium nitrate.
 - a. Calculate the mass of the sample in grams.

 - b. How many formula units of calcium nitrate are present?

 - c. How many nitrate ions are present?

3. Answer the following questions for the compound aluminum chloride.
 - a. What is the molar mass of this compound?

 - b. What is the mass of a 0.65 mole sample?

 - c. How many formula units are in the 0.65 mole sample?

 - d. How many ions are in the 0.65 mole sample?

 - e. How many protons are in the 0.65 mole sample?

9. Find the empirical formula for each compound.
- Empirical formula CH_2 (molar mass = 42.08 g/mol)
 - Empirical formula NO_2 (molar mass = 92.02 g/mol)
 - Empirical formula CHN (molar mass = 135.14 g/mol)
10. Cortisol (molar mass = 362.47 g/mol) is a steroid hormone involved in protein synthesis. Medically, it is used to reduce inflammation from arthritis. Cortisol is 69.6% C, 8.34% H, and 22.1% O by mass. What is its molecular formula?
11. Calculate the mass (in grams) of each product formed when 43.82 g of diborane (B_2H_6) reacts with excess water.
- $$\text{B}_2\text{H}_6(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_3\text{BO}_3(\text{s}) + \text{H}_2 \quad [\text{unbalanced}]$$
12. Calculate the mass of each product formed when 174 g of silver sulfide reacts with excess hydrochloric acid.
- $$\text{Ag}_2\text{S}(\text{s}) + \text{HCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{H}_2\text{S}(\text{g}) \quad [\text{unbalanced}]$$

Answers: 1a) $\text{Al}_2(\text{SO}_4)_3$: 342.145 g/mol 1b) 513 g 1c) 1.08×10^{25} O atoms 2a) 71.1 g 2b) 2.61×10^{23} formula units 2c) 5.21×10^{23} nitrate ions 3a) AlCl_3 : 133.33 g/mol 3b) 87 g 3c) 3.9×10^{23} formula units 3d) 1.6×10^{24} ions 3e) 2.5×10^{25} protons 4a) 53.1 g 4b) 32.3 g 5a) 1.71×10^{24} atoms C 5b) 1.71×10^{22} atoms C-13 6a) 9.7 g MnSO_4 6b) 44.6 mol $\text{Fe}(\text{ClO}_4)_3$ 6c) 1.74×10^{24} N atoms 7) 1.31×10^{24} atoms Ni 8a) 6.375 % H 8b) 71.52 % O 9a) C_3H_6 9b) N_2O_4 9c) $\text{C}_5\text{H}_5\text{N}_5$ 10) $\text{C}_{21}\text{H}_{30}\text{O}_5$ 11) 195.8 g H_3BO_3 and 19.16 g H_2 12) 201 g AgCl and 23.9 g H_2S