

AP Chemistry ~ Summer Review Packet

There are several important reasons for doing AP Chemistry homework over the summer: • To review basic concepts you learned when you took first-year chemistry • To practice math skills which you will need for AP Chemistry • To hit the ground running when we return in the fall. AP chemistry covers a lot of concepts at a fast pace. We need to get started right away and not waste time going over things you already know. This assignment is meant to be a review. We will spend the first few weeks of the year going into some of the assigned chapters in more depth and so, if you have some questions while you are doing the summer assignment, you will have a chance to ask.

Some great resources as you review:

www.chemmybear.com

www.chemreview.net

www.adriandingleschemistrypages.com

<https://www.khanacademy.org/>

<http://www.brightstorm.com/science/chemistry/>

- Memorize Charges of Common Ions

1. This is a vital part of AP chemistry. They will not give you an ion chart so it is essential that you have this done prior to school beginning. I suggest notecards and lots of practice.

For an ion list go to this link <https://www.adriandingleschemistrypages.com/apions.pdf>

Prefixes for naming molecular (covalent) compounds – Greek

1 = mono-	5 = penta-	9 = nona-
2 = di-	6 = hexa-	10 = deca-
3 = tri-	7 = hepta-	
4 = tetra-	8 = octa-	

Elements that exist as diatomic molecules

Br I N Cl H O F
Other weirdos Br₂ I₂ N₂ Cl₂ H₂ O₂ F₂
P₄ and S₈

Naming Acids

Binary acids – named after anion

Hydro-(element)-ic acid Ex. HBr hydrobromic acid

Oxyacids – named after polyatomic anion, no hydro prefix

-ate becomes -ic acid Ex. H₃PO₄ phosphoric acid

-ite becomes -ous acid Ex. H₂SO₃ sulfurous acid

- . Strong acids: There are 8 common strong acids:

HCl - hydrochloric acid	HBr - hydrobromic acid	HI - hydriodic acid
HClO ₄ – perchloric acid	HNO ₃ – nitric acid	HIO ₄ – periodic acid
H ₂ SO ₄ – sulfuric acid	HClO ₃ – chloric acid	

“Strong” means that that are dissociated in aqueous solution. All other acids are weak acids (especially remember CH₃COOH, acetic acid and HF, hydrofluoric acid as weak acids). You should immediately be able to distinguish an acid as weak or strong.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

PERIODIC TABLE OF THE ELEMENTS																		18	
1																		2	
H																		He	
1.008																		4.00	
2																		17	
3																		9	
Li																		Ne	
6.94																		20.18	
11																		17	
Na																		Ar	
22.99																		39.95	
19																		36	
K																		Kr	
39.10																		83.80	
37																		54	
Rb																		Xe	
85.47																		131.29	
55																		86	
Cs																		Rn	
132.91																		(222)	
87																		118	
Fr																		Uuo	
(223)																		(294)	

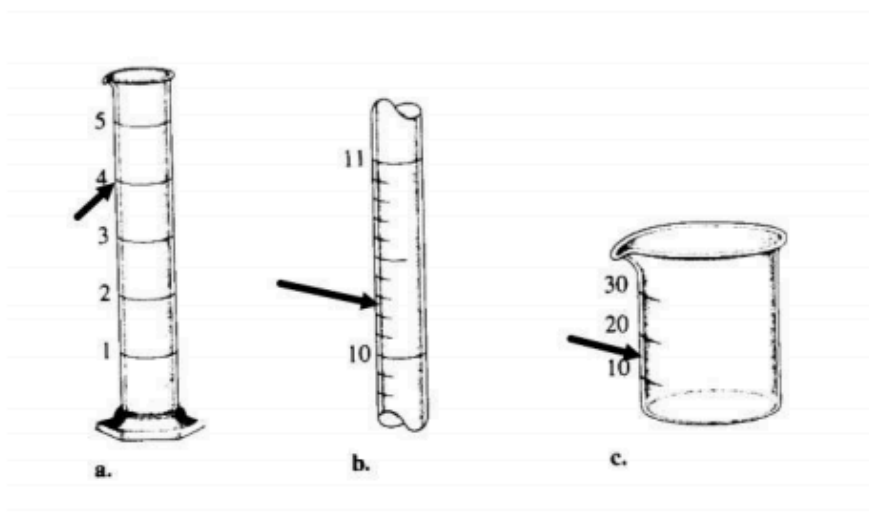
*Lanthanoid Series

†Actinoid Series

58	Ce	140.12	59	Pr	140.91	60	Nd	144.24	61	Pm	150.4	62	Sm	151.97	63	Eu	157.25	64	Gd	158.93	65	Tb	162.50	66	Dy	164.93	67	Ho	167.26	68	Er	168.93	69	Tm	173.05	70	Yb	174.97	71	Lu	
90	Th	232.04	91	Pa	231.04	92	U	238.03	93	Np	(237)	94	Pu	(244)	95	Am	(243)	96	Cm	(247)	97	Bk	(247)	98	Cf	(251)	99	Es	(252)	100	Fm	(257)	101	Md	(258)	102	No	(259)	103	Lr	(262)

Learning Target 1 – I can count the number of significant figures in a measurement.

1. For each of the following pieces of glassware, provide a sample measurement at arrow and discuss the number of significant figures and uncertainty.



2. A student performed an analysis of a sample for its calcium content and got the following results: 14.92%, 14.91%, 14.88%, and 14.91%. The actual amount of calcium in the sample is 15.70%. What conclusion can you draw about the accuracy and precision of these results?
3. Calculate the percent error for the following measurements.
- The density of an aluminum block determined in an experiment was 2.64 g/cm^3 . (Accepted value = 2.70 g/cm^3)
 - The experimental determination of iron in ore was 16.48%. (Accepted value was 16.12%)
4. How many significant figures are in each of the following?
- | | |
|------------------------|-----------------------|
| a. 12 | f. 0.0000101 |
| b. 1098 | g. 1000. |
| c. 2001 | h. 22.04030 |
| d. 2.001×10^3 | i. 1.00×10^3 |
| e. 100 | |

- 1) Count the number of significant figures in the following measurements:

a) 2.71 g _____ b) 0.00047 kg _____ c) $7.0 \times 10^5 \text{ m}$ _____ d) 1,030 L _____
e) 150 pencils _____ f) 37500 g _____ g) 0.1010 cm _____

Learning Target 2 – I can convert numbers to scientific notation while applying significant figures.

- 2) Express each of the following in proper scientific notation (Pay attention to sig figs and units)

a) 0.000125 m _____ b) 155.0 mL _____
c) 123,030,000 kg _____ d) $481.9 \times 10^{-9} \text{ cm}$ _____

Learning Target 3 - *I can add, subtract, multiply, and divide with the correct number of significant figures.*

3) Calculate the correct answer with proper units and sig figs for each of the following:

a) $12 \text{ g} + 0.677 \text{ g} + 86.33 \text{ g} =$ _____

b) $(355.78 \text{ g}) / (0.056 \text{ g}) =$ _____

c) $97.34 \text{ mL} - 34.1 \text{ mL} =$ _____

d) $14.68 \times 5 =$ _____

4) Perform the following calculations with scientific notation and report your answer with the correct number of significant figures.

a) $0.14 \times (6.02 \times 10^{23}) =$ _____

b) $\frac{(9.875 \times 10^4) - (9.795 \times 10^4)}{9.875 \times 10^4} \times 100 \% =$ _____ (assume 100 is exact)

c) $\frac{(3.8 \times 10^{-12}) + (4.0 \times 10^{-13})}{(4 \times 10^{12}) + (6.3 \times 10^{13})} =$ _____

Learning Target 4 - *I can use conversions to solve dimensional analysis problems.*

5) Solve the following problems using conversions and dimensional analysis.

a) A large railroad car is filled with 1745 gallons of milk. The car springs a leak in the bottom, and milk starts dripping out at a rate of 204.84 mL/sec. If the train is traveling at a speed of 65.4 miles per hour, calculate how many miles it will travel before all the milk has drained out of the car.
(1 gal = 3.78 L, 1 mile = 5280 ft, 1 in = 2.54 cm)

b) The world record for the hundred meter dash is 9.77 seconds. What is the corresponding average speed in units of m/sec, km/hr, ft/sec, and miles/hr?

Learning Target 5 - *I can explain density and use the density equation to find an unknown.*

6) A rectangular block has dimensions of 2.9 cm x 3.5 cm x 10.0 cm. The mass of the block is 615.0 grams. What are the volume and the density of the block?

- 7) The density of pure silver is 10.5 g/mL at 20°C. If 5.25 grams of pure silver pellets are added to a graduated cylinder containing 11.2 mL of water, to what volume will the water in the cylinder rise?

Learning Target 6 – *I can define and explain terms that identify physical/chemical characteristics of matter.*

- 8) Define the following terms:
- a) Solid –
 - b) Liquid –
 - c) Gas –
 - d) Pure substance –
 - e) Homogeneous mixture –
 - f) Heterogeneous mixture –
 - g) Chemical change –
 - h) Physical change –
- 9) 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) A car crashes into a wall.
 - h) Sugar dissolves in water.

Learning Target 7 – *I can identify the number of protons, neutrons, and electrons in atoms and isotopes.*

- 10) What number of protons and neutrons are contained in the nucleus of each of the following atoms?
Assuming each atom is uncharged, what number of electrons are present?

- a) ${}_{92}^{235}\text{U}$
- b) ${}_{6}^{13}\text{C}$
- c) ${}_{26}^{57}\text{Fe}$
- d) ${}_{82}^{208}\text{Pb}$

- 11) Complete the following table:

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

Learning Target 8 – *I can define and use the Law of Definite Proportions and the Law of Multiple Proportions.*

12) Explain:

a) Law of Definite Proportions:

b) Law of Multiple Proportions:

13) Solve the following problem:

Tin – Oxygen compound	Tin % by mass	Oxygen % by mass
Stannous oxide	88.10%	11.90%
Stannic oxide	78.70%	21.30%

Tin – Oxygen compound	Tin mass	Oxygen mass
Stannous oxide	100.0 grams	
Stannic oxide	100.0 grams	

a) Use the Law of Definite Proportions to determine the mass of oxygen needed to combine with the given masses of tin for stannous oxide and stannic oxide.

b) Does the Law of Multiple Proportions hold true in this case? Explain why or why not.

Learning Target 9 – *I can name and write formulas for ionic compounds.*

14) Name or give the formula for the following compounds:

<u>Name</u>	<u>Formula</u>
Sodium fluoride	_____
_____	K ₂ O
Calcium phosphate	_____
_____	FeCl ₃
Iron (II) chloride	_____
_____	Hg ₂ O
Sodium sulfate	_____
_____	CaCO ₃
Lithium phosphate	_____
_____	SO ₂
Calcium hydroxide	_____
_____	H ₂ SO ₄
Cupric chloride	_____

Learning Target 10 – *I can write and balance equations.*

Review Reading: www.chymist.com/Equations.pdf

Write and balance the following equations:

- Iron metal reacts with oxygen to form rust, iron (III) oxide.
- Calcium metal reacts with water to produce aqueous calcium hydroxide and hydrogen gas.
- Aqueous barium hydroxide reacts with aqueous sulfuric acid to produce solid barium sulfate and water.

Learning Target 11 – *I can do conversions associated with moles.*

15) Solve the following problems:

- Calculate the mass of 500. Atoms of iron (Fe).
- How many formula units are present in 87.2 grams of lead (IV) carbonate?

- c) Aspartame is an artificial sweetener that is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed as Nutra-Sweet. The molecular formula of aspartame is $C_{14}H_{18}N_2O_5$.
- Calculate the molar mass of aspartame.
 - Calculate the mass, in grams, of 1.56 mol of aspartame.
 - How many molecules are in 5.0 mg of aspartame?
 - How many atoms of nitrogen are in 1.2 g aspartame?
 - What is the mass of one molecule of aspartame?

Learning Target 12 – *I can calculate percent by mass for an element in a compound.*

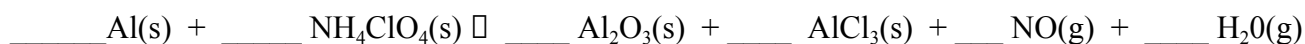
- 16) Calculate the percent by mass for each element in aspartame from the previous problem.

Learning Target 13 – *I can calculate the average atomic mass of an isotope using percent abundance.*

- 17) An element consists of 1.40% of an isotope with a mass of 203.973 amu, 24.10% of an isotope with mass 205.9745 amu, 22.10% of an isotope with mass 206.9759 amu, and 52.40% of an isotope with mass 207.9766 amu. Calculate the average atomic mass and identify the element.

Learning Target 14 – *I can solve stoichiometry problems, include those that use limiting and excess.*

18) The reusable booster rockets of the U.S. space shuttle employs a mixture of aluminum and ammonium perchlorate for fuel. A possible reaction for this is:



- a) Balance the following reaction:
- b) If 4.0 g of aluminum reacted with 15.0 g of ammonium perchlorate, what would be the limiting reactant? How much excess of the other reactant would you have?
- c) Using the above information, how much aluminum chloride would be produced in grams?
- d) If you actually collected 4.18 g of aluminum chloride what would be your percent yield?

19) You add aluminum to a solution of copper (II) chloride and it reacts exothermically. Write and balance the equation below.

- a) If you react 1.25 g of Al, how much copper (II) chloride do you need to add for the Al to fully react?
- b) How much of each product would you collect?

20) When 125.0 g of ethylene (C_2H_4) burns in 60.0 grams of oxygen to give carbon dioxide and water, how many grams of CO_2 are formed? (Hint: balance the equation and determine limiting reactant first)

Learning Target 15 – *I can determine the empirical and molecular formula by calculation.*

21) Phenol is a compound that contains 76.57% carbon, 6.43% hydrogen, and 17.0% oxygen.

a) Calculate the empirical formula.

b) If its molecular weight is 188 g/mol, what would be its molecular formula?

Learning Target 16 - *I can calculate the empirical formula of an unknown hydrocarbon through a combustion reaction and calculation.*

22) One killer of a problem – a GOLD STAR if you can get this one:

Menthol, the substance we can smell in mentholated cough drops, is composed of carbon, hydrogen, and oxygen. A 0.1005 gram sample of menthol is combusted producing 0.2829 g of CO₂ and 0.1159 g of H₂O. What is the empirical formula for menthol? Show work.

More Practice

1. Solve each of the following problems. Report your answers with the correct number of significant figures.

a. $16.5 + 8 + 4.73 =$

b. $23.27 - 12.058 =$

c. $0.0853 + 0.05477 + 0.0002 =$

d. $35 / 0.0622 =$

e. $3400 \times 0.00800 =$

f.
$$\frac{(43.1 + 27.250) \times (22.514 - 18.0)}{0.00155 \times 22.1011} =$$

2. Solve the following problems using dimensional analysis. Report your answers with the correct number of significant figures.
- Your plumber discovers a small leak that is leaking water at a rate of 1.2 mL per hour. How many Liters of water are leaked in exactly one week?
 - You visit the Willis Tower. You notice that every room in the Willis Tower has 18 lights on the ceiling and get curious about how many lights are in the whole building. There are 110 floors in the Willis Tower, and each floor has 98 rooms in it. Wow! How many total lights are in the Willis Tower?
 - Dr. Ott can run a marathon (26.2 miles) in 2.925 hours. What is his average speed in meters per second? (1 meter = 3.28 feet, 1 mile = 5280 feet)
3. Solve the following density problems:
- The density of a copper cube is 8.92 g/mL. If that cube had its volume computed to be 74 mL, what is the mass of that cube?
 - Using water displacement, a fine young chemist decides to submerge an iron ($D = 7.6$ g/mL) chunk into a graduated cylinder with 20.0 mL of water. If the cylinder has a mass of 67 grams, what is the final volume in the graduated cylinder?
 - You go fishing and obtain some lead weights for your trip. Since you are the smartest chemistry student in the land, you know that lead's density is 11.34 g/mL. If there are 50 weights in a 250. mL box, what is the mass of each weight?
 - A student pipettes 5.00 mL of ethanol into a flask that has a mass of 15.25 grams. She finds the mass of the flask plus ethanol is 19.17 grams. Calculate the density of ethanol.
4. Identify the following as a physical property, physical change, chemical property, or chemical change.
- Ethanol has a density of 0.697 g/mL.
 - The solution turns blue upon mixing two clear aqueous solutions.
 - Wood burns in an oven.
 - Methyl alcohol is highly flammable.
 - Ice melts in a beaker.
 - Methyl ethanoate smells like green apple.
 - A car crashes into a wall.
 - Sugar dissolves in water.

5. Complete the following table concerning an atom/ion and its subatomic particles:

Mass #	Atomic #	# of Protons	# of Neutrons	# of Electrons	Symbol
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41	19				
					$^{16}_{8}\text{O}^{-2}$
			35	32	
					$^{198}_{78}\text{Pt}$
		10	13		

6. Answer the following questions which deal with the Laws of Definite and Multiple Proportions:
- Nitrogen (N) and silicon (Si) form two binary compounds with the following compositions:

Compound	Mass % N	Mass % Si
1	33.28	66.72
2	39.94	60.06

 - Compute the mass of silicon that combines with 1.000 g of nitrogen in each case.
 - Show that these compounds satisfy the Law of Multiple Proportions. If the second compound has the formula Si_3N_4 , what is the formula of the first compound?
 - A 57.6 gram sample of methane (CH_4) is found to contain 43.2 grams of carbon. How much hydrogen, in grams, would a 37.8 gram sample of methane contain?

7. Name or form the following ionic compounds:

<u>Name</u>	<u>Formula</u>
a. Lithium oxide	_____
b. _____	$\text{Mg}(\text{NO}_3)_2$
c. Calcium nitride	_____
d. _____	$(\text{NH}_4)_2\text{SO}_4$
e. Iron (II) carbonate	_____
f. _____	Cu_2S

8. Write and balance the following chemical equations:

- _____ $\text{Cu}_{(s)} + \text{_____ } \text{Al}_2\text{O}_{3(aq)} \rightarrow \text{_____ } \text{CuO}_{(aq)} + \text{_____ } \text{Al}_{(s)}$
- _____ $\text{C}_4\text{H}_{10(l)} + \text{_____ } \text{O}_{2(g)} \rightarrow \text{_____ } \text{CO}_{2(g)} + \text{_____ } \text{H}_2\text{O}_{(g)}$
- _____ $(\text{NH}_4)_2\text{SO}_{4(aq)} + \text{_____ } \text{Fe}(\text{NO}_3)_{3(aq)} \rightarrow \text{_____ } \text{Fe}_2(\text{SO}_4)_3(s) + \text{_____ } \text{NH}_4\text{NO}_{3(aq)}$
- Hydrogen peroxide decomposes into water and oxygen gas.
- Sodium metal reacts with aqueous barium fluoride....
- Aqueous strontium acetate reacts with aqueous potassium hydroxide....
- Pentanol ($\text{C}_5\text{H}_{11}\text{OH}$) is combusted in air.

9. Calculate the following using molar conversions:

- Find the number of moles in 75.5 grams of aluminum hydroxide.
- How many molecules are in 35.5 grams of carbon dioxide?
- How many atoms of nitrogen are in 4.33 moles of calcium nitrate?
- Find the mass that is equivalent to 0.056 moles of sugar ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$).

v. How many atoms of hydrogen can be found in 100. grams of acetic acid?

10. Determine the percentage by mass for the given element/molecule in each problem:

- % carbon in C_8H_{18}
- % oxygen in magnesium phosphate
- % aluminum in aluminum acetate
- % water in $BaSO_4 \cdot 2 H_2O$

11. Calculate the average atomic mass of an isotope given their masses and relative abundances.

a.

Isotope	% Abundance
Chlorine – 35	75.77%
Chlorine – 37	24.23 %

b.

Isotope	% Abundance
Ar – 36	3.36 %
Ar – 38	9.50 %
Ar – 40	31.55 %

12. Solve the following stoichiometry problems:

- $CaCl_{2(aq)} + Al_2O_{3(s)} \rightarrow CaO_{(s)} + AlCl_{3(aq)}$
 - How many moles of calcium chloride would react with 5.99 moles of aluminum oxide?
 - If 2.44 moles of calcium oxide are made, how many grams of aluminum chloride are also made?
 - If 14.5 grams of $CaCl_2$ react with excess Al_2O_3 , how many grams of CaO are produced?
- Ammonium chloride reacts with lead (IV) nitrate.
 - If 18.5 grams of each reactant is present:
 - Which reactant limits?
 - How many grams of the excess reactant would remain?
 - How much lead (IV) chloride is made?
 - If 9.50 grams of lead (IV) chloride are experimentally made, what is the percent yield?
- Hexane (C_6H_{14}) is combusted in air.
 - Write the balanced equation for the combustion reaction.
 - How many moles of carbon dioxide are made if 43.0 grams of oxygen gas react?
 - If 3.22 grams of hexane react with 10.4 grams of oxygen gas, what is the maximum mass of water vapor that can be produced?

13. Determine the empirical and molecular formulas given the following information:

- Methyl butanoate has a percent composition of 58.8% C, 9.8% H, and 31.4% O. Its molecular weight is 102 g/mol. Find its molecular formula.

- b. A compound is found to have 9.09 g C, 1.52 g H, and 14.4 g F. What is its empirical formula? If the compound has a molecular mass of 66 g/mol, what is its molecular formula?