

AP Chemistry Summer Work Packet 2020 - 2021

All students taking AP Chemistry are required to complete a review packet prior to the start of the course. The course packet is designed to help the student review material found in Chapters 1 – 3 of the textbook and represents work learned in in a first year Chemistry class. The Assignment is due to be collected the first day of class and will count as 10% toward the first Assessment.

Name: _____

PERIODIC TABLE OF THE ELEMENTS

1 H 1.008																	2 He 4.00
3 Li 6.94	4 Be 9.01															9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.30															17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.91	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 *La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.2	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.02	89 †Ac 227.03	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Rg (272)							
*Lanthanide Series																	
58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97				
†Actinide Series																	
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)				

AP Required Memorization – Charges of Ions

POSITIVE IONS: - periodic table connections

+1		+2		+3		+4		+5	
Group 1		Group 2		Group 13		Group 14		Group 15	
Alkali		Alkaline Earth		Boron		Carbon		Nitrogen	
Li ⁺¹	Lithium	Be ⁺²	Beryllium	Al ⁺³	Aluminum	Si ⁺⁴	Silicon(IV)	As ⁺⁵	Arsenic (V)
Na ⁺¹	Sodium	Mg ⁺²	Magnesium	Ga ⁺³	Gallium	Ge ⁺⁴	Germanium(IV)	Bi ⁺⁵	Bismuth(V)
K ⁺¹	Potassium	Ca ⁺²	Calcium						
Rb ⁺¹	Rubidium	Sr ⁺²	Strontium						
Cs ⁺¹	Cesium	Ba ⁺²	Barium						
Fr ⁺¹	Francium	Ra ⁺²	Radium						

NEGATIVE IONS: - periodic table connections

-4		-3		-2		-1	
Group 14		Group 15		Group 16		Group 17	
Carbon		Nitrogen		Oxygen		Halogens	
C ⁻⁴	Carbide	N ⁻³	Nitride	O ⁻²	Oxide	F ⁻¹	Fluoride
		P ⁻³	Phosphide	S ⁻²	Sulfide	Cl ⁻¹	Chloride
				Se ⁻²	Selenide	Br ⁻¹	Bromide
						I ⁻¹	Iodide

VARIABLE CHARGES/TRANSITION METALS:

Hydrogen	+1 or -1	Chromium (II) or (III)	+2 or +3
Iron (II) or (III)	+2 or +3	NO ROMAN NUMERALS	
Copper (I) or (II)	+1 or +2	Silver	+1
Mercury (I) or (II)	+1 or +2	Zinc	+2
Tin (II) or (IV)	+2 or +4	Cadmium	+2
Lead (II) or (IV)	+2 or +4	Nickel	+2
Cobalt (II) or (IV)	+2 or +4		
Manganese (II) or (IV)	+2 or +4		

POLYATOMICS IONS

+1

ammonium	NH ₄ ⁺¹
hydronium	H ₃ O ⁺¹

-1

Acetate	C ₂ H ₃ O ₂ ⁻¹ or	Hydroxide	OH ⁻¹
CH ₃ COO ⁻¹		Nitrate	NO ₃ ⁻¹
Azide	N ₃ ⁻¹	Nitrite	NO ₂ ⁻¹
Bromate	BrO ₃ ⁻¹	Perchlorate	ClO ₄ ⁻¹
Cyanide	CN ⁻¹	Chlorate	ClO ₃ ⁻¹
Dihydrogen phosphate	H ₂ PO ₄ ⁻¹	Chlorite	ClO ₂ ⁻¹
Bicarbonate or	HCO ₃ ⁻¹	Hypochlorite	ClO ⁻¹
Hydrogen carbonate		Iodate	IO ₃ ⁻¹
Bisulfate or	HSO ₄ ⁻¹	Permanganate	MnO ₄ ⁻¹
Hydrogen sulfate		Thiocyanate	SCN ⁻¹

<u>-2</u>			
Carbonate	CO_3^{-2}	Oxalate	$\text{C}_2\text{O}_4^{-2}$
Chromate	CrO_4^{-2}	Silicate	SiO_3^{-2}
Dichromate	$\text{Cr}_2\text{O}_7^{-2}$	Tetraborate	$\text{B}_4\text{O}_7^{-2}$
Hydrogen phosphate	HPO_4^{-2}	Peroxide	O_2^{-2}
Sulfate	SO_4^{-2}	Selenate	SeO_4^{-2}
Sulfite	SO_3^{-2}	Tartrate	$\text{C}_4\text{H}_4\text{O}_6^{-2}$
Thiosulfate	$\text{S}_2\text{O}_3^{-2}$		

<u>-3</u>	
Phosphate	PO_4^{-3}
Phosphite	PO_3^{-3}
Arsenate	AsO_4^{-3}
Borate	BO_3^{-3}

*Reminder NH_3 = ammonia

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
IN	Cl	H	O	F		
Other weirdos	P_4 and S_8					

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. H_3PO_4 phosphoric acid

-ite becomes -ous acid Ex. H_2SO_3 sulfurous acid

. Strong acids: There are 8 common strong acids:

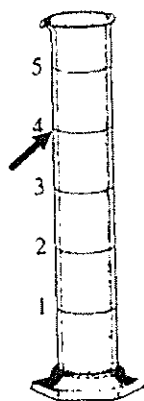
HCl - hydrochloric acid	HBr - hydrobromic acid	HI - hydriodic acid
HClO_4 – perchloric acid	HNO_3 – nitric acid	HIO_4 – periodic acid
H_2SO_4 – sulfuric acid	HClO_3 – chloric acid	

“Strong” means that that are dissociated in aqueous solution. All other acids are weak acids (especially remember CH_3COOH , acetic acid and HF, hydrofluoric acid as weak acids). You should immediately be able to distinguish an acid as weak or strong.

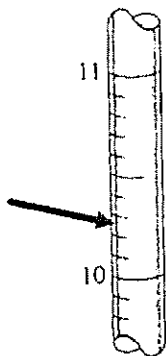
Practice Problems

CHAPTER 1

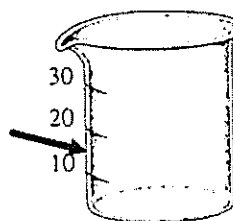
1. For each of the following pieces of glassware, provide a sample measurement at arrow and discuss the number of significant figures and uncertainty.



a.



b.



c.

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/cm³. (Accepted value = 2.70 g/cm³)
 - 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 x 10 ³ | i. 1.00 x 10 ³ |
| e. 100 | |
5. Round each of the following numbers to two significant figures, and write the answers in scientific notation.
- | | |
|---------------|---------------|
| a. 0.00031254 | c. 35,900 |
| b. 31,254,000 | d. 0.00000399 |
6. Use scientific notation to express the number 480 to
- One significant figure
 - Two significant figures
 - Three significant figures
7. Perform the following mathematical operations, and express each result to the correct number of significant figures.
- $97.381 + 4.2502 + 0.99195$
 - $171.5 + 72.915 - 8.23$
 - $\frac{0.102 \times 0.0821 \times 273.5}{1.2}$
 - $(9.04 - 8.23 + 21.954 + 81.0) / 3.1416$

8. Precious metals and gems are measured in troy weights in the English system:
- 24 grains = 1 pennyweight (EXACT)
 - 20 pennyweights = 1 troy ounce (EXACT)
 - 12 troy ounces = 1 troy pound (EXACT)
 - 1 grain = 0.0648 gram
 - 1 carat = 0.200 gram
- a. Diamonds are measured in carats. If a lucky girl receives a 5 carat diamond how many pennyweights is it?
 - b. What is the mass of 2.3 troy ounces of gold in grams?
 - c. The density of gold is 19.3 g/cm³. What is the volume of a troy pound of gold?
9. Apothecaries (druggists) use the following set of measures:
- 20 grains ap = 1 scruple (EXACT)
 - 3 scruples = 1 dram ap (EXACT)
 - 8 dram ap = 1 oz. ap (EXACT)
 - 1 dram ap = 3.888 g
- a. An aspirin table contains 5.00 x 10² mg of active ingredient. How many grains ap of active ingredient does it contain?
 - b. From (a) how many scruples?
 - c. What is the mass of 1.00 scruple in grams?
10. The world record for the hundred meter dash is 9.79 s. What is the corresponding speed in units of m/s, km/hr, ft/s, and mi/hr?
- a. At this speed how long would it take to run a mile (5,820 ft)?
11. You're planning to buy a new car. One model that you're considering gets 32 miles per gallon of gasoline in highway travel. The one that your spouse likes gets 14 kilometers to the liter. Which car has the better gas mileage? (1 gal = 4 qt., 1.057 qt = 1 L)
12. You pass a road sign saying "New York – 112 km." If you drive at a constant speed of 65 mi/hr., how long should it take you to reach New York?
- a. If your car gets 28 miles to the gallon, how many liters of gasoline are necessary to travel 112 km?
13. You have a 1.0 cm³ sample of lead and a 1.0 cm³ sample of glass. You drop each in separate beakers of water. How do the volumes of water displaced by each sample compare? Explain.
 Density of lead = 11.35 g/cm³
 Density of glass = 3.00 g/cm³
14. A person has a temperature of 102.5 F. What is this temperature on the Celsius scale?
- a. On the Kelvin scale?
15. Convert the following Celsius temperatures to Kelvin and to Fahrenheit degrees.
- a. The boiling-point temperature of ethyl alcohol, 78.1 C
 - b. A cold winter day, -25 C
 - c. The lowest possible temperature, -273 C
 - d. The melting-point temperature of sodium chloride, 801 C
16. The density of diamond is 3.51 g/cm³. What is the volume of a 4.5 carat diamond? 1 carat = 0.200 g
17. The volume of a diamond is found to be 2.8 mL. What is the mass of the diamond in carats? (See question #16)
18. A sample containing 33.42 g of metal pellets is poured into a graduated cylinder initially containing 12.7 mL of water, causing the water level in the cylinder to rise to 21.6 mL. Calculate the density of the metal.

19. Two spherical objects have the same mass. One floats on water; the other sinks. Which object has the greater diameter? Explain your answer.
20. What are some of the differences between a solid, a liquid, and a gas?
21. What is the difference between homogeneous and heterogeneous matter?
22. Classify each of the following as homogeneous or heterogeneous.
- soil
 - the atmosphere
 - a carbonated soft drink
 - gasoline
 - gold
 - a solution of ethanol and water
23. Classify each of the following as a mixture or a pure substance. Of the pure substances, which are elements and which are compounds?
- | | |
|---------------|----------------------|
| a. Water | f. Uranium |
| b. Blood | g. Wine |
| c. The oceans | h. Leather |
| d. Iron | i. Table salt (NaCl) |
| e. Brass | |
24. Distinguish between physical and chemical changes.
25. List four indications that a chemical change (reaction) has occurred.
26. If you place a glass rod over a burning candle, the glass appears to turn black. What is happening to each of the following (physical change, chemical change, both, or neither) as the candle burns? Explain each answer
- the wax
 - the wick
 - the glass rod
27. The properties of a mixture are typically averages of the properties of its components. The properties of a compound may differ dramatically from the properties of the elements that combine to produce the compound. For each process described below, state whether the material being discussed is most likely a mixture or a compound, and state whether the process is a chemical change or a physical change.
- An orange liquid is distilled, resulting in the collection of a yellow liquid and a red solid.
 - A colorless, crystalline solid is decomposed, yielding a pale yellow-green gas and a soft, shiny metal.
 - A cup of tea becomes sweeter as sugar is added to it.

CHAPTER 2

- Describe Dalton's atomic theory.
- What discoveries were made by J.J. Thomson, Henri Becquerel, and Lord Rutherford? How did Dalton's model of the atom have to be modified to account for these discoveries?
- What is the distinction between atomic number and mass number?
- What is the difference between atomic mass and average atomic mass?
- What is an isotope?

6. How many protons and neutrons are contained in the nucleus of each of the following atoms?
- | | |
|----------------------------|----------------------------|
| a. ${}_{22}\text{Ti}^{42}$ | d. ${}_{36}\text{Kr}^{86}$ |
| b. ${}_{30}\text{Zn}^{64}$ | e. ${}_{33}\text{As}^{75}$ |
| c. ${}_{32}\text{Ge}^{76}$ | f. ${}_{19}\text{K}^{41}$ |
7. Write the isotopic symbol for each of the isotopes below.
- Atomic number = 8, number of neutrons = 9
 - The isotope of chlorine in which mass = 37
 - Atomic number = 27, mass = 60
 - Number of protons = 26, number of neutrons = 31
 - The isotope of I with a mass number of 131
 - Atomic number = 3, number of neutrons = 4
8. The element copper has naturally occurring isotopes with mass number of 63 and 65. The relative abundance of the isotopes are 69.2% for mass = 62.93 amu, and 30.8% for mass = 64.93 amu. Calculate the average atomic mass of copper.
9. An element consists of 1.40% of an isotope with mass 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.
10. Distinguish between the terms *family* and *period* in connection to the periodic table. For which of these terms is the term *group* also used?
11. In the periodic table, what is the name of the following groups
- Group (2)
 - Group (18)
12. An ion contains 50 protons, 68 neutrons, and 48 electrons. What is its symbol and charge?
13. Which of the following sets of elements are all in the same group in the periodic table?
- | | |
|--------------|-----------|
| a. N, P, O | c. Rb, Sn |
| b. C, Si, Ge | d. Mg, Ca |
14. Identify each of the following elements:
- A member of the same family as oxygen whose most stable ion contains 54 electrons
 - A member of the alkali metal family whose most stable ion contains 36 electrons
 - A noble gas with 18 protons in the nucleus
 - A halogen with 85 protons and 85 electrons
15. Would you expect each of the following atoms to gain or lose electrons when forming ions? What ion is the most likely in each case?
- | | | |
|-------|-------|-------|
| a. Na | d. Ba | g. Al |
| b. Sr | e. I | h. S |
| c. P | f. O | |
16. For each of the following ions, indicate the total number of protons and electrons in the ion. For the positive ions, predict the formula of the simplest compound formed between itself and oxide. For the negative ions predict the simplest compound formed between itself and aluminum.
- | | | |
|---------------------|---------------------|---------------------|
| a. Fe^{+2} | d. Cs^{+1} | g. Br^{-1} |
| b. Fe^{+3} | e. S^{-2} | h. N^{-3} |
| c. Ba^{+2} | f. P^{-3} | |
17. An element's most stable ion forms an ionic compound with bromine, having the formula XBr_2 . If the ion of element X has a mass number of 230 and 86 electrons, what is the identity of the element, and how many neutrons does it have?

For the following:

- Write the correct chemical formula
- Determine the percent composition of each element in the compound

1. Aluminum oxide _____
2. Potassium cyanide _____
3. Ammonium chloride _____
4. Zinc carbonate _____
5. Iron (II) sulfide _____
6. Cesium bromide _____
7. Aluminum sulfide _____
8. Strontium chlorate _____
9. Cobalt (II) nitrate _____
10. Lithium bicarbonate _____

For the following, write the correct chemical name of the compound:

1. CO _____
2. LiHCO_3 _____
3. CS_2 _____
4. HgO _____
5. H_2S _____
6. HI_0 _____
7. $\text{Cr}(\text{ClO})_3$ _____
8. Na_2O_2 _____
9. CO_2 _____
10. $\text{Ba}(\text{ClO}_3)_2$ _____
11. $\text{Co}(\text{NO}_3)_2$ _____

Given:

1 mol = 6.02×10^{23} particles

1 mol = Molar Mass (Gram Formula Mass expressed in grams)

1 mol = 22.4 L for a gas at STP

Mole-Particle Conversions:

- How many moles of magnesium is 3.01×10^{22} atoms of magnesium?
- How many molecules are there in 4.00 moles of glucose, $C_6H_{12}O_6$?

Mole-Mass Conversions:

- How many moles in 28 grams of CO_2 ?
- What is the mass of 5 moles of Fe_2O_3 ?

Mole-Volume Conversions:

- Determine the volume, in liters, occupied by 0.030 moles of a gas at STP.
- How many moles of argon atoms are present in 11.2 L of argon gas at STP?

Mixed Mole Conversions:

- How many oxygen molecules are in 3.36 L of oxygen gas at STP?
- Find the mass in grams of 2.00×10^{23} molecules of F_2 .
- Determine the volume in liters occupied by 14 g of nitrogen gas at STP.
- Find the mass, in grams, of 1.00×10^{23} molecules of N_2 .