2024-2025 AP Chemistry Summer Assignment

Future AP Chemistry Student,

Welcome to AP Chemistry! I look forward to meeting/seeing you in the fall. To ensure the best start for everyone, I have prepared a summer assignment that reviews basic chemistry concepts. If you have taken HS chemistry before, then this material will be an essential review. If you have never taken chemistry, then this material will build the foundation you will need to begin learning college-level chemistry on the first day. I expect you to be proficient in topics covered in Chemistry 1, especially stoichiometry and naming/writing formulas. We will do some review, but extensive remediation is not an option as we work towards our goal of being 100% prepared for the AP Exam in early May 2024.

Be prepared for a course that is graded with college-level expectations. The majority of the grade is based on formal assessments (tests) and laboratory investigations at a level to prepare you for the AP test. There will also be homework grades but do not expect any curves, reassessments, or "fluff" assignments. Be aggressive in pursuit of knowledge not just the grades. Prioritize your time, do not procrastinate until the last moment, get help in class, participate in class discussions, and seek support before grades sink.

Spread out the summer assignment. Please do not try to complete it all in the final week of the summer. Chemistry takes time to process and grasp at a level necessary for success in AP Chemistry. Remember, AP Chemistry is an equivalent course to Introductory Chemistry in college. Taking a college-level course in high school is difficult, requires dedication, and is a great investment in your education so prepare yourself and arrive ready to learn.

Have a great summer and I look forward to an exciting, challenging year of chemistry,

Mrs. House

Summer Assignment:

Use print and internet resources to complete the following problems. Show work for all the problems. ONLY handwritten answers on a SEPARATE sheet of paper will be accepted! You do NOT have to rewrite the questions nor write in complete sentences. USE SIGNIFICANT FIGURES and include units when necessary. Completed work must be submitted by Tuesday, August 6th , 2024. Let me know if there are any problems in completing the assignment on time. A list of resources recommended by the College Board has been provided for your reference. You do not need all the resources to complete the assignment. Any basic chemistry textbook, your old chemistry notes, or a Google search can help you find the information needed to complete the summer assignment. The URLs below represent a fraction of the available chemistry sites available. Please feel free to expand the list and find other websites that help prepare you for the coming year. I recommend that you complete as many online quizzes as possible, take detailed notes, and practice the items indicated in the packet.

http://media.collegeboard.com/digitalServices/pdf/ap/ap-chemistry-course-and-exam-description.pdf
http://www.collegeboard.com/ap/students/chemistry/index.html
www.chemmybear.com (Note: hyperlink doesn't work, but it is a great website!)
https://chemfiesta.org
http://science.widener.edu/svb/tutorial/rxnbalancingcsn7.html
http://www.chemistry-drills.com/balance.html
www.chemteam.info
https://www.youtube.com/user/tdewitt451

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1) Explain the rule for determining the number of significant figures in a given value.
2) Explain the process of measuring (volume, length, temperature, etc.) using appropriate significant figures.
3) Explain the rules for determining sig figs when multiplying or dividing AND adding or subtracting.
4) Express the following in scientific notation:
    a. 0.0000902
    b. 0.00755
    c. 77,000,000,000
    d. 231,000
5) Convert the following values:
    a. 78.90 cm into km
    b. 9.00×10^{23} µm into Mm
    c. 36.0 cm/s to miles/hour
    d. 13.6 g/mL into kg/m^3
6) Label each of the following as either a physical process or a chemical process.
    a. Corrosion of aluminum metal.
    b. Melting of ice.
    c. Pulverizing an aspirin.
    d. Digesting a candy bar.
    e. Explosion of nitroglycerin.
    f. Sublimation of dry ice (CO_2)
7) You may notice when water boils, you can see bubbles that rise to the surface of the water.
    a. What is inside these bubbles?
    b. Is the boiling of water a chemical or physical change? Explain.
8) Explain the main differences between the solid, liquid, and gas phase of matter.
9) Define the words: atomic number, atomic mass, mass number, molecular formula, empirical formula, isotopes, cation, anion, polyatomic ion, metalloid, alloy and allotrope.
10) Dalton assumed that all atoms of the same element were identical in all their properties. Explain why this assumption is not valid.
11) State the contribution of the following chemists:
    a. Democritus
    b. Mendeleev
    c. J.J. Thompson
    d. Faraday
    e. Chadwick
    f. Millikan
    g. Madam Curie
    h. Dalton
    i. Rutherford
12) Explain the differences between element, compound, mixture, and solution.
13) In an experiment, a student gently heated a hydrated copper hydrate to remove the water from the copper. The following data was recorded: Calculate the experimental percent of water in the compound.

Mass of crucible, cover, and contents before heating	23.4 g.
Mass of empty crucible and cover	18.82 g.
Mass of crucible, cover, and contents after heating to constant mass	20.94 g.

14) Determine the number of protons, neutrons, and electrons in the following:
    a. $^{7}_{3}Li^{+1}$
    b. $^{35}_{17}Cl^{-}$
    c. $^{24}_{12}Mg^{+2}$
15) Copper is made up of two isotopes, Copper- 63 and Copper-65. Cu-63 is 69.16% abundant. Calculate the average atomic mass.

16) A sample of naturally occurring Silicon consists of Si-28, Si-29, and Si-30. Si-28 is 92.23% abundant, Si- 29 is 4.67% and the remainder is Si-30. Calculate the average atomic mass of silicon.
17) Gallium has 2 common isotopes, Ga- 69 and Ga- 71. Which isotope is the most abundant and how do you know?
18) Write the electron configuration (long hand or short hand) for the following AND draw the orbital diagram:
    a. O^{2-}
    b. Ca
    c. Cl
    d. Mg^{+2}
19) Explain the following trends across a period and down a column on the periodic table:
    a. Atomic radius
    b. Ionization energy
    c. Electronegativity
20) Explain the rules for naming ionic compounds (type 1 and type 2, with and without polyatomic ions).
21) Explain the rules for writing formulas for ionic compounds (with and without polyatomic ions).
22) Explain the rules for naming covalent compounds.
23) Explain the rules for writing formulas for covalent compounds.
24) Explain the rules for naming acids (binary and ternary).
25) Explain the rules for writing formulas for acids.
26) Why do we call $Ba(NO_3)_2$ barium nitrate, but we call $Fe(NO_3)_2$ iron(II) nitrate?
27) Name the following and indicate if the substance is acidic, covalent, or ionic:
    a. HI
    b. $TiNO_3$
    c. $(NH_4)_2O$
    d. H_2CO_3
    e. FeS
    f. $HClO_2$
    g. C_2H_4
    h. HCN
    i. N_2
    j. PO_5
    k. $CuCrO_4$
    l. $LiClO_4$
28) Write the formula for the following and indicate if the substance is acidic, covalent, or ionic.
    a. Silver chloride
    b. Sodium Dichromate
    c. Sulfuric acid
    d. Cobalt (II) acetate
    e. Calcium phosphide
    f. Nickel (I) hydroxide
    g. Hydrogen gas
    h. Carbon monoxide
    i. Gold (III) fluoride
    j. Triphosphorous octahydride
    k. Phosphorous acid
    l. Ammonia
    m. Hydrobromic acid
29) Draw the Lewis structure for the following:
    a. N_2
    b. NH_3
    c. CO_3^{2-}
    d. CH_3Cl
    e. O_3

30) What is the difference between a polar molecule and a polar bond?
31) What are the solubility rules?
32) Write the chemical equation for the following reactions. Be sure to balance and include states of matter:
    a. Solid magnesium reacts with a solution of zinc nitrate.
    b. Aluminum metal reacts with sulfuric acid.
    c. Fluorine gas reacts with potassium chloride.
    d. Cobalt reacts with chlorine gas to produce cobalt (II) chloride.
    e. Sodium carbonate decomposes to produce sodium oxide and carbon dioxide gas.
    f. Methane gas combusts.
    g. Ethane gas (C_2H_6) is burned in oxygen gas.
    h. Calcium hydroxide neutralizes hydrobromic acid.
    i. Ammonium chloride reacts with a solution of silver nitrate.
33) Write the net ionic equation and identify the spectator ions for the following:
    a. Hydrochloric acid is neutralized with a solution of sodium hydroxide
    b. Acetic acid reacts with a solution of calcium hydroxide
    c. Silver chloride solution reacts with nitric acid solution
34) Washing soda is a hydrate of sodium carbonate. Its formula is $Na_2CO_3 \cdot xH_2O$. A 2.714 g Sample of washing soda is heated until a constant mass of 1.006 g of Na_2CO_3 is reached. What is x?
35) Determine the empirical and molecular formula Ibuprofen, a headache remedy that contains 75.6 % C, 8.80 % H, and 15.5 % O by mass and has a molar mass about 206 g/mol.
36) Calculate the percent composition of oxygen in the following:
    a. H_2O
    b. $Al_2(SO_4)_3$
    c. $C_6H_{12}O_6$
37) A compound is 79.08% carbon, 5.54% hydrogen, and 15.38% nitrogen. What is the molecular formula of this substance if the molar mass is 273.36 g/mol?
38) How many atoms are contained in 3.46 moles of magnesium?
39) What mass would 4.50L of helium gas be at STP?
40) Convert 256.3 g of Na_2CO_3 to atoms of Na.
41) What is the mass of 12.4 molecules of carbon tetrachloride?
42) How many moles are contained in 0.43 g of Al_2O_3?
43) Hydrogen gas and chlorine gas combine in a synthesis reaction. If 43g of hydrochloric acid are produced, how many grams of hydrogen gas was used?
44) What mass of water can be produced when 5.87g of magnesium hydroxide reacts with 75.0 mL of 1.50 M sulfuric acid to produce liquid water and magnesium sulfate? Identify the limiting reactant.
45) How much excess reactant remains when 7.81g of hydrochloric acid reacts with 5.24g of sodium hydroxide and produces liquid water and sodium chloride?
46) How many moles of $Ca(OH)_2$ will be produced when 43.25g of calcium carbide (CaC_2) reacts with 33.71g of liquid water to produce calcium hydroxide and acetylene (C_2H_2)?
47) 3.74 g of sodium metal reacts with oxygen to produce sodium peroxide. If 5.34 g of sodium peroxide are recovered from this reaction, what is the percent yield?
48) What mass of cesium acetate are dissolved in 890. mL of a 0.900 M solution?
49) What is the molarity that was made by dissolving 250. g of hydrobromic acid in 675 mL of solution?
50) Your teacher asks you to prepare 500. mL of a 2.75 molar solution of NaCl for a lab. Write a step-by-step procedure describing how you would carry out this task.
51) Describe the step-by-step process of diluting 0.50L of a 1.0M solution of NaCl to a 0.50M solution of NaCl.
52) If 45 mL of water is added to 250mL of a 0.75 M K_2SO_4 solution, what will the molarity of the diluted solution be?
53) How much of a 5.00 M stock solution of copper (II) sulfate is needed to make 500.0 mL of a 0.35M solution?
54) If 10.0 mL of a 2.25 M sodium carbonate solution reacts with excess iron (III) chloride solution, what mass of iron (III) carbonate precipitates out of solution? ___$FeCl_3(aq)$ + ___$Na_2CO_3(aq)$ → ___$Fe_2(CO_3)_3(s)$ + ___$NaCl(aq)$
55) What volume of 0.20 M $AgNO_3$ will be needed to react completely with 25.0 mL of 0.50 M potassium phosphate?
    ___ $AgNO_3$ + ___ K_3PO_4 → ___ Ag_3PO_4 + ___ KNO_3

Metric Conversions to Memorize:

Prefix	Abbreviation	Meaning	Amount = 1 base unit (g, L, m)
Giga	G	1 gigameter (Gm) = 1 x 10^9 m	1 g = 1 x 10^{-9} Gg
Mega	M	1 megameter (Mm) = 1 x 10^6 m	1 g = 1 x 10^{-6} Mg
Kilo	k	1 kilometer (km) = 1 x 10^3 m	1 g = 1 x 10^{-3} kg
Hecto	h	1 hectometer (hm) = 1 x 10^2 m	1 g = 1 x 10^{-2} hg
Deka	D or da	1 dekameter (Dm) = 1 x 10^1 m	1 g = 1 x 10^{-1} dag
Base Unit (g, L, m)			1 g = 1 x 10^0 g
Deci	d	1 decimeter (dm) = 1 x 10^{-1} m	1 g = 1 x 10^1 dg
Centi	c	1 centimeter (cm) = 1 x 10^{-2} m	1 g = 1 x 10^2 cg
Milli	m	1 millimeter (mm) = 1 x 10^{-3} m	1 g = 1 x 10^3 mg
Micro	µ (Greek letter mu)	1 micrometer (µm) = 1 x 10^{-6} m	1 g = 1 x 10^6 µg
Nano	n	1 nanometer (nm) = 1 x 10^{-9} m	1 g = 1 x 10^9 ng
Pico	p	1 picometer (pm) = 1 x 10^{-12} m	1 g = 1 x 10^{12} pg

Polyatomic Ions to Memorize:

TABLE 4.4

Names of Common Polyatomic Ions

Ion	Name	Ion	Name
NH_4^+	ammonium	CO_3^{2-}	carbonate
NO_2^-	nitrite	HCO_3^-	hydrogen carbonate (bicarbonate is a widely used common name)
NO_3^-	nitrate		
SO_3^{2-}	sulfite		
SO_4^{2-}	sulfate	ClO^-	hypochlorite
HSO_4^-	hydrogen sulfate (bisulfate is a widely used common name)	ClO_2^-	chlorite
		ClO_3^-	chlorate
OH^-	hydroxide	ClO_4^-	perchlorate
CN^-	cyanide	$C_2H_3O_2^-$	acetate
PO_3^{3-}	phosphite	MnO_4^-	permanganate
PO_4^{3-}	phosphate	$Cr_2O_7^{2-}$	dichromate
HPO_4^{2-}	hydrogen phosphate	CrO_4^{2-}	chromate
$H_2PO_4^-$	dihydrogen phosphate	O_2^{2-}	peroxide

Solubility Rules to Memorize		
Soluble		
	Ions	***Exceptions***
Rule #1	Group 1 metals, Ammonium (NH_4^+)	NONE
Rule #2	Nitrate, Acetate, Chlorate, Perchlorate (NO_3^-, $C_2H_3O_2^-$, ClO_3^-, ClO_4^-)	NONE
Rule #3	Chloride, Bromide, Iodide (Cl^-, Br^-, I^-)	Silver, Mercury (II), Mercury (I), Lead (II) (Ag^+, Hg^{+2}, Hg_2^{+2}, Pb^{+2}) *Note: Copper (II) is insoluble with Iodide ion (Cu^{+2})
Rule #4	Sulfate (SO_4^{2-})	Silver, Mercury (I), Lead (II), Calcium, Strontium, Barium (Ag^+, Hg_2^{+2}, Pb^{+2}, Ca^{+2}, Sr^{+2}, Ba^{+2})
Insoluble		
	Ions	***Exceptions***
Rule #5	Sulfide, Fluoride, Carbonate, Phosphate, Sulfite, Chromate (S^{2-}, F^-, CO_3^{2-}, PO_4^{3-}, SO_3^{2-}, CrO_4^{2-})	Group 1 metals, Ammonium (NH_4^+)
Rule #6	Hydroxide, Oxide (OH^-, O^{2-})	Group 1 metals, Ammonium, Calcium, Strontium, Barium (NH_4^+, Ca^{+2}, Sr^{+2}, Ba^{+2})

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1																	18
1 **H** 1.008	2											13	14	15	16	17	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30	3	4	5	6	7	8	9	10	11	12	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	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** 65.38	31 **Ga** 69.72	32 **Ge** 72.63	33 **As** 74.92	34 **Se** 78.97	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** 95.95	43 **Tc** (97)	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** 121.76	52 **Te** 127.60	53 **I** 126.90	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** 183.84	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)	89 **†Ac** (227)	104 **Rf** (267)	105 **Db** (270)	106 **Sg** (271)	107 **Bh** (270)	108 **Hs** (277)	109 **Mt** (276)	110 **Ds** (281)	111 **Rg** (282)	112 **Cn** (285)	113 **Uut** (285)	114 **Fl** (289)	115 **Uup** (288)	116 **Lv** (293)	117 **Uus** (294)	118 **Uuo** (294)

*Lanthanoid 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** 173.05	71 **Lu** 174.97
†Actinoid 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)