AP Chemistry – Intro & Summer Assignment

Welcome to AP Chemistry! I hope you are ready for a fun and challenging year. Students who finish AP Chemistry have a much better understanding of the world around them, are better prepared for other college courses and come out with a sense of great accomplishment.

AP Chemistry is a challenging class, but it can be a lot of fun! Like most AP classes, AP Chem comes with a summer assignment which is meant to help you review some of the most important concepts you learned in your first year of chemistry.

If you have questions about the assignment or the course, please contact Mr. Pell at spell@bishopoconnell.org.

Important Information Regarding the Course

Textbook: Your textbook for the course will be *Chemistry: The Molecular Nature of Matter and Change* by Silberberg and Amateis, from McGraw Hill (ISBN 978-1259631757). We will be using the 8th edition, which has a release date of June 6, 2018.

You have two options for purchasing the textbook: 1) You may buy a print copy off of amazon.com, for a price of $174. 2) You may rent a copy off of amazon, for a price of $36.29. 3) You may rent a one-year online subscription to the textbook, for a price of $30. I will give you an online access code on the first day of school. If you select Option 3, you must have an electronic device capable of accessing the online textbook in class. Since I assume most of you will select Options 2 or 3, O'Connell will not offer any textbooks through the textbook sale.

Optional Review Book: I would highly recommend purchasing an AP Chemistry review book this summer. Review books contain a simplified presentation of the topics, extra practice problems organized by topic, and full-length practice exams. Some popular titles are:

1. *5 Steps to a 5: AP Chemistry* (ISBN: 978-1259911255) from McGraw Hill. The authors of this text are members of the the AP Chemistry Exam-Writing Committee.
2. *CliffsAP: Chemistry* (ISBN: 978-0544370005) from CliffsNotes.
3. *Barron's AP Chemistry, 8th Edition* (ISBN 978-1438007373)
4. *Cracking the AP Chemistry Exam: 2018 Edition* (ISBN 978-1524710033) from the Princeton Review

Summer Assignment: Attached is a two-part summer assignment. Part One consists of memorizing polyatomic ions and the common charges of elements. Part Two consists of practice problems on topics you will need to have mastered when you come to school on the first day.

The summer assignment is due the first day of school. I will collect it for a 10-point completion grade, but the quality of your answers will determine your level of readiness for the course. Expect a quiz on polyatomic ions, ionic charges, significant figures, dimensional analysis, atomic structure, chemical nomenclature, and mole conversions during the first week of school.

Edpuzzle: I will often assign you video lessons for homework. I post videos on a website called EdPuzzle. Your first videos will be posted before you leave for summer break. They are optional, but they should assist you in the summer assignment. To access the videos, go to www.edpuzzle.com and login as a student. Select "Log in with Google" and use your school gmail account. Click "Join Class" and type in the code "**nisitmi**." This should allow you to join the class "AP Chemistry 2018-2019," where you should see videos that correlate to topics in the summer assignment.

Summer Assignment Part 1: Memorizing Polyatomic Ions and Ionic Charges

You are responsible for knowing the names, formulas, and charges of the most common polyatomic ions. You are also responsible for knowing the charges of the most common elemental ions. You will be quizzed on this information during the first week of school.

Polyatomic ions containing oxygen are named according to a systematic nomenclature, based on the number of oxygens attached to the central atom.

For instance, chlorate is ClO_3^-, chlorite is ClO_2^-, perchlorate is ClO_4^-, and hypochlorite is ClO^-

The –ate form of the ion is the most common form. The –ite form always has one less oxygen than the –ate, the per___ –ate form has one more than the –ate form, and the hypo____–ite form always has two less oxygens than the –ate form.

Mneumonic for remembering 5 of the most common –ates:

Nick the camel ate a clam supper in Phoenix

Or, to be comprehensive: Nick the Monk ate an Inch Clam for Supper in Phoenix. His Camel ate the Best Crepes in Atlanta. (Credit Will Becht)

1. The first letter (or 2 in the case of the clam) of the word tells you which ion it is (i.e. nitrate, carbonate, chlorate, sulfate, phosphate)
2. The number of consonants is equal to the number of oxygens
3. The number of vowels is equal to the charge

Example: N***i***ck – Nitrate is NO_3^-

The table below contains all of the oxyanions (anions containing oxygen) you are responsible for memorizing. They are organized according to their prefix, explained above.

Hypo____ite	ClO^- Hypochlorite	BrO^- Hypobromite	IO^- Hypoiodite								
____ite	ClO_2^- Chlorite	BrO_2^- Bromite	IO_2^- Iodite		NO_2^- Nitrite	SO_3^{2-} Sulfite	PO_3^{3-} Phosphite				
____ate	ClO_3^- Chlorate	BrO_3^- Bromate	IO_3^- Iodate	CO_3^{2-} Carbonate	NO_3^- Nitrate	SO_4^{2-} Sulfate	PO_4^{3-} Phosphate		AsO_4^{3-} Arsenate	CrO_4^{2-} Chromate	$C_2O_4^{2-}$ Oxalate
per____ate	ClO_4^- Perchlorate	BrO_4^- Perbromate	IO_4^- Periodate					MnO_4^- Permanganate			

Those that have a charge of greater magnitude than –1 many pick up additional hydrogens (H^+ ions). You are also responsible for memorizing these ions:
HCO_3^- (hydrogen carbonate), HSO_3^- (hydrogen sulfite), HSO_4^- (hydrogen sulfate), $HC_2O_4^-$ (hydrogen oxalate),
HPO_4^{2-} (hydrogen phosphate), $H_2PO_4^-$ (dihydrogen phosphate)

In addition, you must memorize the charge, formula, and name of the following ions:

Additional ions:

Ammonium: NH_4^+
Hydronium: H_3O^+
Hydroxide: OH^-
Cyanide: CN^-
Acetate: $C_2H_3O_2^-$
Azide: N_3^-

Thiocyanate: SCN^-
Peroxide: O_2^{2-}
Thiosulfate: $S_2O_3^{2-}$ (sulfate where one of the oxygens has been exchanged for a sulfur)
Dichromate: $Cr_2O_7^{2-}$ (a variant of chromate that has two chromiums and the same charge)

Below is a periodic table with the possible charges for each element. While you do not need to memorize all of these, you do need to know that Group 1 ions have a +1 Charge, Group 2 ions have a +2 Charge, Aluminum has a +3 Charge, Group 15 nonmetal ions have a -3 Charge, Group 16 nonmetal ions have a -2 Charge, Group 17 nonmetal ions have a -1 Charge, and Group 18 nonmetal ions have a Charge of Zero.

Atomic Ions
Dominant form on top

1A	2A	3B	4B	5B	6B	7B	8B			1B	2B	3A	4A	5A	6A	7A	0
H^+																	He
Li^+	Be^{2+}											B	C	N^{3-}	O^{2-}	F^-	Ne
Na^+	Mg^{2+}											Al^{3+}	Si	P^{3-}	S^{2-}	Cl^-	Ar
K^+	Ca^{2+}	Sc^{3+}	Ti^{3+} Ti^{4+}	V^{3+} V^{5+}	Cr^{3+} Cr^{2+}	Mn^{2+} Mn^{4+}	Fe^{2+} Fe^{3+}	Co^{2+} Co^{3+}	Ni^{2+} Ni^{3+}	Cu^{2+} Cu^+	Zn^{2+}	Ga^{3+}	Ge^{4+}	As^{3-}	Se^{2-}	Br^-	Kr
Rb^+	Sr^{2+}	Y^{3+}	Zr^{4+}	Nb^{5+} Nb^{3+}	Mo^{6+}	Tc^{7+}	Ru^{3+} Ru^{4+}	Rh^{3+}	Pd^{2+} Pd^{4+}	Ag^+	Cd^{2+}	In^{3+}	Sn^{4+} Sn^{2+}	Sb^{3+} Sb^{5+}	Te^{2-}	I^-	Xe
Cs^+	Ba^{2+}	La^{3+}	Hf^{4+}	Ta^{5+}	W^{6+}	Re^{7+}	Os^{4+}	Ir^{4+}	Pt^{4+} Pt^{2+}	Au^{3+} Au^+	Hg^{2+} Hg^+	Tl^+ Tl^{3+}	Pb^{2+} Pb^{4+}	Bi^{3+} Bi^{5+}	Po^{2+} Po^{4+}	At^-	Rn
Fr^+	Ra^{2+}	Ac^{3+}															

Summer Assignment Part 2: Practice Problems

Complete the following problems on a separate sheet of paper. An answer key is given at the end of this packet. If you get stuck, consult the relevant sections of your Chemistry 1 textbook. Video lessons can be found on Edpuzzle. I will collect your work on the first day of school.

Significant Figures

Perform the following mathematical operations, and express the result to the correct number of significant figures.

1. 8.317×4.31
2. $\frac{56.3}{2.5167}$
3. $4.587 + 5.6$
4. $78.679 - 57$
5. $\frac{2.526}{3.1} + \frac{0.470}{0.623} + \frac{80.705}{0.4326}$
6. $(6.404 \times 2.91)/(18.7-17.1)$
7. $\frac{9.5+4.1+2.8+3.175}{4}$
   (Assume that this operation is taking the average of four numbers. Thus the 4 in the denominator is exact.)
8. $\frac{8.925-8.905}{8.925} \times 100$
   (This type of calculation is done many times in calculating a percent error. Assume that this example is such a calculation; thus 100 can be considered to be an exact number.)

Dimensional Analysis and Density Problems

9. You are in Paris, and you want to buy some peaches for lunch. The sign in the fruit stand indicates that peaches cost 2.45 euros per kilogram. Given that 1 euro is equivalent to approximately $1.32, calculate what a pound of peaches will cost in dollars.
10. Diamond are measured in carats, and 1 carat = 0.200 g. The density of diamond is 3.51 g/cm^3. 1 cm^3 = 1 mL.
    a. What is the volume of a 5.0-carat diamond?
    b. What is the mass in carats of a diamond with a volume of 2.8 mL?
11. The density of pure silver is 10.5 g/cm^3 at 20 degrees C. If 5.25 g of pure silver pellets is added to a graduated cylinder containing 11.2 mL of water, to what volume level will the water in the cylinder rise?

12. Secretariat is the horse with the fastest run in the Kentucky Derby. If Secretariat's record 1.25 mile run lasted 1 minute 59.2 seconds, what is his average speed in m/s?
13. Many times errors are expressed in terms of percentage. The percent error is the difference between the true value and the experimental value, divided by the true value, and multiplied by 100%.

$$Percent\ error = \frac{(true\ value - experimental\ value)}{true\ value} \times 100\%$$

Calculate the percent error in the following measurements:

a) The density of an aluminum block determined in an experiment was 2.64 g/cm^3. The true value is 2.70 g/cm^3.
b) The experimental determination of iron in iron ore was 16.48%. The true value is 16.12%.
c) A balance measured the mass of a 1.000-g standard as 0.9981 g.

Law of Conservation of Mass, Law of Definite Proportions

14. A sample of H_2SO_4 contains 2.02 g of hydrogen, 32.07 g of sulfur, and 64.00 g of oxygen. How many grams of sulfur and grams of oxygen are present in a second sample of H_2SO_4 containing 7.27 g of oxygen?
15. In a combustion reaction, 46.0 g of ethanol reacts with 96.0 g of oxygen to produce water and carbon dioxide. If 54.0 g of water is produces, what mass of carbon dioxide is produced?
16. Indium oxide contains 4.784 g of indium for every 1.000 g of oxygen. In 1869, when Mendeleev first presented his version of the periodic table, he proposed the formula In_2O_3 for indium oxide. Before that time it was thought that the formula was InO. What values for the atomic mass of indium are obtained using these two formulas? Assume that oxygen has an atomic mass of 16.00 amu.

Atomic Structure

17. Identify the elements that correspond to the following atomic numbers. Label each as either a noble gas, a halogen, an alkali metal, and alkaline earth metal, a transition metal, a lanthanide metal, or an actinide metal:

a. 17	e. 2
b. 4	f. 92
c. 63	g. 55
d. 72	

18. Write the atomic symbol (^A_ZX) for each of the following isotopes.
    e. Z = 8, number of neutrons = 9
    f. The isotope of boron with mass number 10
    g. Z = 12, A = 23
    h. Atomic number 53, number of neutrons = 79
    i. Z = 20, number of neutrons = 27
    j. Number of protons = 29, mass number 65

19. Complete the following table:

Symbol	# of protons	# of neutrons	# of electrons	Net Charge
$^{57}_{26}Fe^{+2}$				
	26	33		3+
	85	125	86	
	13	14	10	
		76	54	2-

Chemical Nomenclature

20. Name each of the following compounds. Assume the acids are dissolved in water.
    a. $HC_2H_3O_2$
    b. NH_4NO_2
    c. Co_2S_3
    d. ICl
    e. $Pb_3(PO_4)_2$
    f. $KClO_3$
    g. H_2SO_4
    h. Sr_3N_2
    i. $Al_2(SO_3)_3$
    j. SnO_2
    k. Na_2CrO_4
    l. HClO

21. Write the formula for the following compounds:
    g. Ammonium hydrogen phosphate
    h. Mercury (I) sulfide
    i. Silicon dioxide
    j. Sodium sulfite
    k. Aluminum hydrogen sulfate
    l. Nitrogen trichloride
    m. Hydrobromic acid
    n. Bromous acid
    o. Perbromic acid
    p. Potassium hydrogen sulfide
    q. Calcium iodide
    r. Cesium perchlorate

Average Atomic Mass

22. The element silver (Ag) has two naturally occurring isotopes: ^{109}Ag and ^{107}Ag with a mass of 106.905 amu. Silver consists of 51.82% ^{107}Ag and has an average atomic mass of 107.868 amu. Calculate the mass of ^{109}Ag.

Mole conversions

23. A diamond contains 5.0×10^{21} atoms of carbon. What amount (moles) of carbon and what mass (grams) of carbon are in this diamond?

24. Bauxite, the principal ore used in the production of aluminum, has a molecular formula of $Al_2O_3 \cdot 2H_2O$. The $\cdot H_2O$ in the formula are called waters of hydration. Each formula unit of the compound contains two water molecules.
    a. What is the molar mass of bauxite?
    b. What is the mass of aluminum in 0.58 mole of bauxite?
    c. How many atoms of aluminum are in 0.58 mole of bauxite?
    d. What is the mass of 2.1×10^{24} formula units of bauxite?

25. What amount (moles) is represented by each of these samples?
    a. 20.0 mg caffeine, $C_8H_{10}N_4O_2$
    b. 2.72×10^{21} molecules of ethanol, C_2H_5OH
    c. 1.50 g of dry ice, CO_2

Balancing Chemical Equations

Write balanced chemical equations for the following reactions:

26. The combustion of ethanol (C_2H_5OH) forms carbon dioxide and water vapor. A combustion reaction refers to a reaction of a substance with oxygen gas.
27. Aqueous solutions of lead (II) nitrate and sodium phosphate are mixed, resulting in the precipitate formation of lead (II) phosphate with aqueous sodium nitrate as the other product.
28. Solid zinc reacts with aqueous HCl to form aqueous zinc chloride and hydrogen gas.
29. Aqueous strontium hydroxide reacts with aqueous hydrobromic acid to produce water and aqueous strontium bromide.

ANSWER KEY:

It is your responsibility to obtain correct solutions to all 29 practice problems before the first day of school. If you have any questions about any of these problems, send me an e-mail at spell@bishopoconnell.org.

1. 35.8
2. 22.4
3. 10.2
4. 22
5. 188.1
6. 12
7. 4.9 (Uncertainty appears in the first decimal place. The average of several numbers can only be as precise as the least precise number. Averages can be exceptions to the significant figure rules.)
8. 0.22
9. $1.47/lb
10.
    a. 0.28 cm^3
    b. 49 carats
11. 11.7 mL
12. 16.9 m/s
13.
    a. 2%
    b. 2.2%
    c. 0.2%
14. 115.4 g sulfur, 230.3 g oxygen
15. 88.0 g of carbon dioxide
16. 76.52 g/mol for InO; 114.8 g/mol for In_2O_3
17.
    a. Chlorine (Cl); halogen
    b. Beryllium (Be); alkaline earth metal
    c. Europium (Eu); lanthanide metal
    d. Hafnium (Hf); transition metal
    e. Helium (He); noble gas
    f. Uranium (U); actinide metal
    g. Cesium (Cs); alkali metal
18.
    a. $^{17}_{8}O$
    b. $^{37}_{17}Cl$
    c. $^{60}_{27}Co$
    d. $^{57}_{26}Fe$
    e. $^{131}_{53}I$
    f. $^{7}_{3}Li$

19.

Symbol	# of protons	# of neutrons	# of electrons	Net Charge
$^{57}_{26}Fe^{2+}$	26	31	24	2+
$^{59}_{26}Fe^{3+}$	26	33	23	3+
$^{210}_{85}At^{1-}$	85	125	86	1-
$^{27}_{13}Al^{3+}$	13	14	10	3+
$^{128}_{52}Te^{2-}$	52	76	54	2-

20.

a. Acetic acid
b. Ammonium nitrite
c. Cobalt (III) sulfide
d. Iodine monochloride
e. Lead (II) phosphate
f. Potassium chlorate
g. Sulfuric acid
h. Strontium nitride
i. Aluminum sulfite
j. Tin (IV) oxide
k. Sodium chromate
l. Hypochlorous acid

21.

a. $(NH_4)_2HPO_4$
b. Hg_2S
c. SiO_2
d. Na_2SO_3
e. $Al(HSO_4)_3$
f. NCl_3
g. HBr
h. $HBrO_2$
i. $HBrO_4$
j. KHS
k. CaI_2
l. $CsClO_4$

22. 108.9 u

23. 0.0083 mol C; 0.010 g C

24.
   a. 101.96 g/mol + 36.00 g/mol = 137.96 g/mol
   b. 31 g
   c. (0.58 mol * 6.022×10^{23}*2) = 7.0×10^{23} Al atoms
   d. ($2.1 \times 10^{24}/6.022 \times 10^{23}$*137.96) = 480 g

25.
   a. (.0200 g * the molar mass of caffeine) 1.03×10^{-4} mol
   b. ($2.72 \times 10^{24}/6.022 \times 10^{23}$; note this doesn't depend on the identity of the sample) 0.00452 mol
   c. (1.50 g / 44.0) = 0.0341 mol

26. $2\ C_2H_5OH_{(g)} + 3\ O_{2\ (g)} \rightarrow 2\ CO_{2\ (g)} + 3\ H_2O_{(g)}$
27. $3\ Pb(NO_3)_{2\ (aq)} + 2\ Na_3PO_{4\ (aq)} \rightarrow 3\ Pb_3(PO_4)_{2\ (s)} + 6\ NaNO_{3\ (aq)}$
28. $Zn_{\ (s)} + 2\ HCl_{(aq)} \rightarrow ZnCl_{2\ (aq)} + H_{2\ (g)}$
29. $Sr(OH)_{2\ (aq)} + 2\ HBr_{\ (aq)} \rightarrow 2\ H_2O_{(l)} + SrBr_{2\ (aq)}$