Hanford High School

May 25, 2016

Dear Future AP Chemistry Student,

Welcome to Advanced Placement Chemistry! I look forward to our journey to deepen your knowledge and understanding of chemistry. AP Chemistry is a college level science class that is challenging, rigorous and intense. Through discipline, hard work and good problem solving skills it will also be very rewarding.

The jump from General Chemistry to AP Chemistry is quite significant. This packet contains materials that will help bridge the gap to AP Chemistry. Doing this work will better prepare you to dive into the course content when the new school year begins. Much of the work is an extension of work already done in General Chemistry, but there is some new content. There will be a quiz over the memorization on the first day of school. We will review the summer work during the first week of class and have a test over this content during the second week of school. There is no need to master everything this summer. The idea is that the reading and notes are done and there is evidence of the questions being attempted.

Packet Contents:

- Periodic Table: A copy of the periodic table that you get to use on the AP exam and on class quizzes and tests. Notice that only the symbol of the element appears. You will need to learn the chemical names and symbols.
- The Common Polyatomic Ions: There is a list of ions as well as some information about the historic names of some of these ions. The formulas, charges and names of these ions need to be memorized before the first day of class. They will be used in class and on the AP exam.
- Solubility Rules: Same as above. Like the polyatomic ions, solubility rules are required knowledge for the AP test. There won't be questions specifically on them, but you will need to know them to answer other questions.
- Chapters 1-3 from "Chemistry" 8th edition by Zumdahl, Zumdahl: Read the chapters and take notes. Complete the questions provided. These questions are simply for practice working with the material. Make sure you either know how to answer these problem types or arrive the first day with specific questions you need help with.

IMPORTANT: Please send me an email (samuel.koch@rsd.edu) with your email address ASAP. Use an email that you check regularly. In mid-August I will send out an email with information about a work day prior to the start of school. This will be an opportunity to meet everybody in the class, do any class set-up and maybe go over some questions from the summer packet. YES, attendance at this "work day" will earn extra credit!

I am looking forward to working with you this fall.

Mr. Koch
samuel.koch@rsd.edu
https://sites.google.com/site/apchem2606/

AP Chemistry Textbook Assignment

"Chemistry" 8th edition by Zumdahl, Zumdahl text Chapters 1 "Chemical Foundations", Chapter 2 "Atoms, Molecules and Ions", Chapter 3 "Stoichiometry"; Read the chapters and take notes. Complete the questions provided. The class website has some resources (text PowerPoints etc) on the links page) https://sites.google.com/site/apchem2606/

Chapters 1 "Chemical Foundations"
1.2 The Scientific Method - Question: #19
1.3 Units of Measure - Questions: #23, 39
1.4 Uncertainty in Measure - Questions: #11, 22
1.5 Significant Figures and Calculations - Questions: #29, 30, 31, 33, 34, 37 (From here on, use significant figures in all calculations.)
1.6 Dimensional Analysis - Questions: #41, 43
1.7 Temperature - Question: #55
1.8 Density - Questions: #61, 88
1.9 Classification of Matter - Questions: #28, 73, 90

Chapter 2 "Atoms, Molecules and Ions"
2.1 Early History of Chemistry - No questions, but know the information.
2.2 Fundamental Chemical Laws - Questions #17, 19, 31
2.3 Dalton's Atomic Theory - Question #20
2.4 Early Experiments to Characterize the Atom - Questions #21, 41
2.5 The Modern View of Atomic Structure: An Introduction - Question #22
2.6 Molecules and Ions - Questions #28, 29, 59, 61
2.7 An Introduction to the Periodic Table - Questions #47, 49
2.8 Naming Simple Compounds - Questions #63, 65, 71, 75, 77

Chapter 3 "Stoichiometry"
3.1 Counting by Weight - No questions, but know the information.
3.2 Atomic Masses - Questions #33, 34, 39
3.3 The Mole - Questions #41, 42, 43
3.4 Molar Mass - Questions #26, 47
3.5 Learning to Solve Problems - Questions #49, 51, 55, 57, 64 (It is important to learn and use conceptual problem solving and dimensional analysis to solve problems.)
3.6 Percent Composition of Compounds - Questions #27, 67, 70, 73
3.7 Determining the Formula of a Compound - Questions #75, 76
3.8 Chemical Equations - Questions #28
3.9 Balancing Chemical Equations - Questions #89, 91, 94, 95
3.10 Stoichiometric Calculations: Amounts of Reactants and Products - Questions #99, 101
3.11 The Concept of Limiting Reagent - Questions #29, 30, 31, 107, 114, 119

INFORMATION IN THE TABLE BELOW AND IN THE TABLES ON PAGES 3-5 MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1 **H** 1.008																	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											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** 47.90	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)

GO ON TO THE NEXT PAGE.

Table 2.4 Common Ions

Positive ions (cations)	Negative ions (anions)
1+	1−
Ammonium (NH_4^+)	Acetate ($C_2H_3O_2^-$)
Cesium (Cs^+)	Azide (N_3^-)
Copper(I) or cuprous (Cu^+)	Bromide (Br^-)
Hydrogen (H^+)	Chlorate (ClO_3^-)
Lithium (Li^+)	Chloride (Cl^-)
Potassium (K^+)	Cyanide (CN^-)
Silver (Ag^+)	Dihydrogen phosphate ($H_2PO_4^-$)
Sodium (Na^+)	Fluoride (F^-)
	Hydride (H^-)
2+	Hydrogen carbonate or bicarbonate (HCO_3^-)
Barium (Ba^{2+})	Hydrogen sulfate or bisulfate (HSO_4^-)
Cadmium (Cd^{2+})	Hydroxide (OH^-)
Calcium (Ca^{2+})	Iodide (I^-)
Cobalt(II) or cobaltous (Co^{2+})	Nitrate (NO_3^-)
Copper(II) or cupric (Cu^{2+})	Nitrite (NO_2^-)
Iron(II) or ferrous (Fe^{2+})	Perchlorate (ClO_4^-)
Lead(II) or plumbous (Pb^{2+})	Permanganate (MnO_4^-)
Magnesium (Mg^{2+})	Thiocyanate (SCN^-)
Manganese(II) or manganous (Mn^{2+})	
Mercury(I) or mercurous (Hg_2^{2+})	2−
Mercury(II) or mercuric (Hg^{2+})	Carbonate (CO_3^{2-})
Nickel (Ni^{2+})	Chromate (CrO_4^{2-})
Strontium (Sr^{2+})	Dichromate ($Cr_2O_7^{2-}$)
Tin(II) or stannous (Sn^{2+})	Hydrogen phosphate (HPO_4^{2-})
Zinc (Zn^{2+})	Oxide (O^{2-})
	Peroxide (O_2^{2-})
3+	Sulfate (SO_4^{2-})
Aluminum (Al^{3+})	Sulfide (S^{2-})
Chromium(III) or chromic (Cr^{3+})	Sulfite (SO_3^{2-})
Iron(III) or ferric (Fe^{3+})	
	3−
	Arsenate (AsO_4^{3-})
	Nitride (N^{3-})
	Phosphate (PO_4^{3-})
	Phosphide (P^{3-})

Selected Polyatomic Ions

Hg_2^{2+}	dimercury (I)	$Cr_2O_7^{2-}$	dichromate
NH_4^+	ammonium	MnO_4^-	permanganate
$C_2H_3O_2^-$, CH_3COO^-	acetate	MnO_4^{2-}	manganate
		NO_2^-	nitrite
CN^-	cyanide	NO_3^-	nitrate
CO_3^{2-}	carbonate	OH^-	hydroxide
HCO_3^-	hydrogen carbonate	PO_4^{3-}	phosphate
$C_2O_4^{2-}$	oxalate	SCN^-	thiocyanate
ClO^-	hypochlorite	SO_3^{2-}	sulfite
ClO_2^-	chlorite	SO_4^{2-}	sulfate
ClO_3^-	chlorate	HSO_4^-	hydrogen sulfate
ClO_4^-	perchlorate	$S_2O_3^{2-}$	thiosulfate
CrO_4^{2-}	chromate		

Figure 2.23 Compounds of ions of the same element but with different charge can be very different in appearance. Both substances shown are complex salts of iron with K^+ and CN^- ions. The one on the left is potassium ferrocyanide, which contains the Fe(II) bound to CN^- ions. The one on the right is potassium ferricyanide, which contains the Fe(III) bound to CN^- ions. Both substances are used extensively in blueprinting and other dying processes. (Richard Megna/ Fundamental Photographs)

An older method still widely used for distinguishing between two differently charged ions of a metal is to apply the endings *-ous* or *-ic*. These endings represent the lower and higher charged ions, respectively. They are added to the root of the Latin name of the element:

Fe^{2+}	ferrous ion	Cu^+	cuprous ion
Fe^{3+}	ferric ion	Cu^{2+}	cupric ion

Compounds of differently charged ions of the same element generally exhibit very different properties, including physical appearance (Figure 2.23).

The only common polyatomic cations are those given below:

NH_4^+	ammonium ion	Hg_2^{2+}	mercury(I) or mercurous ion

The name mercury(I) ion is given to Hg_2^{2+} because it can be considered to consist of two Hg^+ ions. Mercury also occurs as the monatomic Hg^{2+} ion, which is known as the mercury(II) or mercuric ion.

Monatomic anions (those derived from a single atom) are most commonly formed from atoms of the nonmetallic elements. They are named by dropping the ending of the name of the element and adding the ending *-ide:*

H^-	hydride ion	O^{2-}	oxide ion	N^{3-}	nitride ion
F^-	fluoride ion	S^{2-}	sulfide ion	P^{3-}	phosphide ion

Only a few common polyatomic ions end in *-ide:*

OH^-	hydroxide ion	CN^-	cyanide ion
O_2^{2-}	peroxide ion	N_3^-	azide ion

Table 2.4 lists the most common cations and anions. Notice that many polyatomic anions contain oxygen. Anions of this kind are referred to as **oxyanions**. A particular element such as sulfur may form more than one oxyanion. When this occurs, there are rules for indicating the relative numbers of oxygen atoms in the anion. When an element forms only two oxyanions, the name of the one that contains more oxygen ends in *-ate;* the name of the one with less oxygen ends in *-ite:*

NO_2^-	nitrite ion	SO_3^{2-}	sulfite ion
NO_3^-	nitrate ion	SO_4^{2-}	sulfate ion

When the series of anions of a given element extends to three or four members, as with the oxyanions of the halogens, prefixes are also employed. The prefix *hypo-* indicates less oxygen, and the prefix *per-* indicates more oxygen:

ClO^-	hypochlorite ion (one less oxygen than chlorite)
ClO_2^-	chlorite ion (one less oxygen than chlorate)
ClO_3^-	chlorate ion
ClO_4^-	perchlorate ion (one more oxygen than chlorate)

Notice that if you memorize the rules just indicated, you need know only the name for one oxyanion in a series to deduce the names for the other members.

Because many names of ions predate the establishment of systematic rules, there are many exceptions to these rules. For example, the permanganate ion is MnO_4^-; we thus expect that the manganate ion should be MnO_3^-, but this ion is unknown. The name manganate is given to the species MnO_4^{2-}.

Selected Solubilities in Water

i—nearly insoluble ss—slightly soluble s—soluble d—decomposes n—not isolated	acetate	bromide	carbonate	chloride	chromate	hydroxide	iodide	nitrate	phosphate	sulfate	sulfide
aluminum	ss	s	n	s	n	i	s	s	i	s	d
ammonium	s	s	s	s	s	s	s	s	s	s	s
barium	s	s	i	s	i	s	s	s	i	i	d
calcium	s	s	i	s	s	ss	s	s	i	ss	d
copper(II)	s	s	i	s	i	i	n	s	i	s	i
iron(II)	s	s	i	s	n	i	s	s	i	s	i
iron(III)	s	s	n	s	i	i	n	s	i	ss	d
lead	s	ss	i	ss	i	i	ss	s	i	i	i
magnesium	s	s	i	s	s	i	s	s	i	s	d
mercury(I)	ss	i	i	i	ss	n	i	s	i	ss	i
mercury(II)	s	ss	i	s	ss	i	i	s	i	d	i
potassium	s	s	s	s	s	s	s	s	s	s	s
silver	ss	i	i	i	ss	n	i	s	i	ss	i
sodium	s	s	s	s	s	s	s	s	s	s	s
zinc	s	s	i	s	s	i	s	s	i	s	i

Solubility of Some Ionic Compounds in Water

Negative Ion	Plus	Positive Ion	Form a Compound which is
Any negative ion	+	Alkali metal ions (Li^+, Na^+, K^+, Rb^+, Cs^+)	Soluble
Any negative ion	+	Ammonium ion, NH_4^+	Soluble
Nitrate, NO_3^-	+	Any positive ion	Soluble
Acetate, CH_3COO^-	+	Any positive ion except Ag^+ or Hg^{2+}	Soluble Not soluble
Chlorine, Cl^-, or Bromide, Br^-, or Iodide, I^-	+ +	Ag^+, Pb^{2+}, Hg^{2+}, or Cu^+ Any other positive ion	Not soluble Soluble
Sulfate, SO_4^{2-}	+	Ca^{2+}, Sr^{2+}, Ba^{2+}, Ra^{2+}, Ag^{2+}, Pb^{2+} Any other positive ion	Not Soluble Soluble
Sulfide, S^{2-}	+ + +	Alkali ions or NH_4^+ Be^{2+}, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Ra^{2+} Any other positive ion	Soluble Soluble Not soluble
Hydroxide, OH^-	+ +	Alkali ions or NH_4^+ Any other positive ion	Soluble Not soluble
Phosphate, PO_4^{3-}, or Carbonate, CO_3^{2-}, or Sulfite, SO_3^{2-}	+ + +	Alkali ions or NH_4^+ Any other positive ion	Soluble Not soluble

Rules for Solubility (Sing to Rhythm of 99 Bottles)
(Taken from Cornell University - Chemistry Department)

Potassium, sodium and ammonium salts,
Whatever they may be,
Can always be depended on for solubility

When asked about the nitrates
The answer is always clear,
They each and all are soluble,
Is all we want to hear.

Most every chloride's soluble
At least we've always read
Save silver, mercurous mercury
And (slightly) chloride of lead

Every single sulfate
Is soluble, 'Tis said
'Cept barium and strontium
And calcium and lead.

Hydroxides of metals won't dissolve
That is, all but three
Potassium, sodium and ammonium
Dissolve quite readily

And then you must remember
That you must not "forgit"
Calcium, barium, strontium
Dissolve a little bit.

The carbonates are insoluble,
It's lucky that it's so,
Or else, our marble buildings
Would melt away like snow.

(Repeat with feeling)
Potassium, sodium, and ammonium salts
Whatever they may be
Can always be depended on
For solubility

by Branton Lachman
Santiag High School