Name:		_ Date	•	CHEM 1A
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Wednesday/Thursday, October 2 & 3, 2019 - Atoms, Ions, and Molecules Practice

I. Warm-Up -

1. On the blank periodic table, indicate where the metals, nonmetals, and metalloids are found. Also show which columns are the noble gases, alkali metals, alkaline earth metals, halogens, and transition metals.

2. Phenomena (Truncated)

What patterns do you notice in the data samples below?

1	1																2
H																	He
Hydrogen 1.00794																	Helium 4.003
3	4]										5	6	7	8	9	10
Li	Be											В	C	N	0	F	Ne
Lithium 6,941	Beryllium 9.012182											Boron 10,811	Carbon 12.0107	Nitrogen 14,00674	Oxygen 15,9994	Fluorine 18,9984032	Neon 20,1797
11	12	1										13	14	15	16	17	18
Na	Mg											Al	Si	P	S	Cl	Ar
Sodium 22.989770	Magnesium 24.3050											Aluminum 26.981538	Silicon 28.0855	Phosphorus 30.973761	Sulfur 32.066	Chlorine 35.4527	Argon 39,948
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Potassium 39.0983	Calcium 40.078	Scandium 44.955910	Titanium 47.867	Varadium 50.9415	Chromium 51.9961	Manganese 54.938049	55.845	Cobult 58.933200	Nickel 58.6934	Copper 63.546	Zinc 65.39	Gallium 69.723	Germanium 72.61	Arsenic 74.92160	Selenium 78.96	Bromine 79.904	Krypton 83.80
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Rubidium 85.4678	Strontium 87.62	Yttrium 88,90585	Zirconium 91.224	Niobium 92.90638	Molybdenum 95.94	Technetium (98)	Ruthenium 101.07	Rhodium 102.90550	Palladium 106.42	Silver 107.8682	Cadmium 112.411	Indium 114.818	Tin 118.710	Antimony 121.760	Tellurium 127.60	lodine 126.90447	Xenon 131.29
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Cesium 132.90545	Barium 137,327	Lanthanum 138.9055	Hafnium 178,49	Tantalum 180,9479	Tungsten 183.84	Rhenium 186,207	Osmium 190.23	192.217	Platinum 195.078	Gold 196.96655	Mercury 200.59	Thallium 204.3833	Lead 207.2	Bismuth 208.98038	Polonium (209)	Astatine (210)	Radon (222)
87	88	89	104	105	106	107	108	109	110	111	112	113	114				
Fr Francium (223)	Ra Radium (226)	Ac Actinium (227)	Rf Rutherfordium (261)	Db Dubrium (262)	Sg Seaborgium (263)	Bh Bohrium (262)	Hs Hassium (265)	Mt Meitnerium (266)	(269)	(272)	(277)						

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Cerium 140,116	Praseodymium 140,90765	Neodymium 144.24	Promethium (145)	Samarium 150.36	Europium 151,964	Gadolinium 157.25	Terbium 158.92534	Dysprosium 162.50	Holmium 164.93032	Erbium 167,26	Thulium 168.93421	Ynerbium 173.04	Lutetium 174,967
90	91	92	93	94	95	96	97	98	99	100	101	102	103
		72 T1											_
Th	Pa	Uranium	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No Nobelium	Lr
232.0381	231.03588	238.0289	Neptunium (237)	Plutonium (244)	Americium (243)	(247)	Berkelium (247)	(251)	(252)	(257)	Mendelevium (258)	(259)	(262)

Substance X	Mass of A	Mass of B		Mass of A	Mass of B
Sample 1	0.86 g	1.96 g	Substance Y	0.86 g	0.98 g
Sample 2	4.26 g	9.73 g	Substance Z	0.43 g	0.25 g
Sample 3	32.8 g	74.9 g			

Play with the data, you'll notice that both the Law of Definite Proportions and the Law of Multiple Proportions both hold true. Assume a formula AB for one of the substances, and figure out what the formulae for the other two substances will be relative to AB.

3. How was the homework? Chapter 2: 28,42,90,91

Law of Conservation of Mass $m_{beginning} = m_{products}$

Law of Definite Proportions

When two or more elements combine to form a compound, their masses in that compound are in a fixed and definite ratio

Law of Multiple Proportions

When two elements form a series of compounds, the ratio of the masses of the second element that combined with 1 gram of the first element can always can be reduced to small whole numbers.

How do we know there are atoms?

4. Compound X₂Y is 60% X by mass. Calculate the percent Y by mass of the compound X₂Y₂.

Assume 100g of X_2Y , therefore 60g in X_2Y and 40g of Y. If one unit of X is 30g, and one unit of Y is 40g in X_2Y , then the percent of Y in X_2Y_2 is given by $\frac{40+40}{30+30+40+40} \times 100\% = 57\% \ Y$ in X_2Y_2 .

II. Ions

1. Predict the charge if the following elements were in their ionic form.

c. Ga (+3)

f. B (+3)

g.
$$Ag(+1)$$

Atoms will gain or lose electrons until they have the same number of electrons as the noble gases.

A positively charged ion is called a <u>cation</u>. They are formed by elements on the <u>left side</u> of the periodic table.

A negatively charged ion is called an__anion__. They are formed by elements on the _right side of the periodic table.

III. Naming Compounds

2. Name the following compounds:

NiNO₃ Nickel (I) nitrate

N₂O₅ dinitrogen pentaoxide

AgBr Silver Bromide

(NH₄)₂CO₃ Ammonium carbonate

H₂SO₃ (aq) Sulfurous Acid SF₆ sulfur hexafluoride

Types of Compounds

Molecular Compound – electrically neutral, sharing electrons, usually only nonmetals

Ionic Compound – held together by electrostatic attraction to be electrically neutral, metal & nonmetal

V. Practice

3. For each of the following determine the number of protons, neutrons and electrons:

a. ⁴⁷Ti

- b. ${}^{90}\text{Sr}^{2+}$
- c. ${}^{32}P^{3-}$

- p = 22
- p=38 n=52
- p = 15n=17

- n=25e = 22
- e = 36
- e = 18
- 4. Fill in the following table

Symbol	³⁷ Cl ⁻	23 Na ⁺	⁸¹ Br ⁻	$^{226}U^{6+}$
# of Protons	17	11	35	92
# of	20	12	46	134
neutrons				
# of	18	10	36	86
electrons				
Mass	37	23	81	226
number				

5. An element's most stable ion forms an ionic compound with chlorine having the formula XCl₂. If the mass number of the ion is 24 and it has 10 electrons, what is the element and how many neutrons does it have?

The ion has a 2+ charge and has 10 electrons, therefore it has 12 protons and is magnesium. 24 mass number - 12 protons = 12 neutrons

- 6. Which of the following represents a pair of isotopes?
 - a. ³²S and ³²S²-
- b. O_2 and O_3
- c. ¹⁵₇N and ¹⁵₈O
- d. ${}^{12}_{6}$ C and ${}^{13}_{6}$ C
- e. ¹⁸/₈O and ¹⁹/₉F
- 7. Here are some common names that you're expected to know write the chemical formula.

a. Water

b. methane CH₄

c. ammonia` NH₃

IV. Name the following compounds:

a. LiHCO₃ Lithium hydrogen carbonate

 H_2O

b. Na₂SO₃ Sodium sulfite

c. (NH₄)₃PO₄ Ammonium Phosphate

d. Fe(OH)₃ Iron(III) hydroxide

e. SnS₂ Tin(II) sulfide

f. HF_(g) Hydrogen fluoride (gas)

g. HClO_(aq) Hypochlorous acid (aq)

h. H₂C₂O_{4(aq)} oxalic acid

i. SBr₆ sulfur hexabromide

j. CO carbon monoxide

k. P₂O₅ diphosphorus pentaoxide

V. What are the names of the following elements: Mo, Mg, and Sn?

Molybdenum, Magnesium, Tin

VI. Predict the formula for the following:

a. calcium cyanide Ca(CN)₂

b. aluminum sulfate Al₂(SO₄)₃

c. lead(IV) oxalate $Pb(C_2O_4)_2$

d. hydrosulfuric acid H₂S

e. sulfuric acid H₂SO₄

f. phosphorous acid H₃PO₄

g. sulfur trioxide SO₃

h. carbon tetrachloride CCl₄

VII. Which one of the following statements about atomic structure is false?

- a. The protons and neutrons in the nucleus are very tightly packed.
- b. The electrons occupy a very large volume compared to the nucleus.
- c. The number of protons and the number of neutrons are always the same in the neutral atom.
- d. Almost all of the mass of the atom is concentrated in the nucleus.
- e. All of the above statements are true.

Atomic Number $(Z) \Rightarrow \#$ of protons

Ne Element Symbol

20.180

Average atomic mass in amu or g/mol

Mass Number $(A) \Rightarrow$ sum of protons and neutrons **Note that mass number is NOT on the periodic table**

Isotopes ⇒

atoms of the same element (same number of protons) with varying number of neutrons (different mass number)

ex: Chlorine has two naturally occurring isotopes

Mass Number (A)

357Cl
Atomic Number (Z)

These can also be written Cl-35 and Cl-37

Naming Ionic Compounds

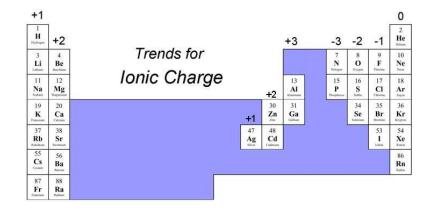
- 1. metals with fixed charges (Grps 1, 2, Al, Ga, Ag, Zn and Cd see diagram below) ⇒ use the elements name as is
- 2. metals with varying charges (all other metals) \Rightarrow use the elements name and a Roman numeral (denotes the charge)
- 3. $NH_4^+ \Rightarrow$ ammonium

The second name is the anion:

- 1. monoatomic \Rightarrow elements name with the suffix –ide
- 2. polyatomic \Rightarrow you'll eventually memorize these names

1⁻ charge 2⁻ charge 3⁻ charge hydroxide ⇒ OH⁻ sulfite ⇒ SO_3^{2-} borate ⇒ BO_3^{3-} cyanide \Rightarrow CN⁻ nitrite $\Rightarrow NO_2^$ nitrate \Rightarrow NO₃⁻ hypochlorite \Rightarrow ClO⁻ chlorite \Rightarrow ClO₂⁻ chlorate \Rightarrow ClO₃⁻ perchlorate \Rightarrow ClO₄⁻ acetate \Rightarrow C₂H₃O₂⁻ hydrogen carbonate ⇒ HCO₃⁻ dihydrogen phosphate ⇒ H₂PO₄⁻ hydrogen sulfite ⇒ HSO₃⁻ hydrogen sulfate ⇒ HSO₄⁻ permanganate ⇒ MnO₄⁻ thiocyanate ⇒ SCN⁻ bromate ⇒ BrO₃⁻ bromite \Rightarrow BrO₂⁻

 $\begin{array}{ll} \text{sulfate} \Rightarrow \text{SO}_4{}^{2-} & \text{phosphite} \Rightarrow \text{PO}_3{}^{3-} \\ \text{carbonate} \Rightarrow \text{CO}_3{}^{2-} & \text{phosphate} \Rightarrow \text{PO}_4{}^{3-} \\ \text{oxalate} \Rightarrow \text{C}_2\text{O}_4{}^{2-} & \text{arsenate} \Rightarrow \text{AsO}_4{}^{3-} \\ \text{hydrogen phosphate} \Rightarrow \text{HPO}_4{}^{2-} \\ \text{chromate} \Rightarrow \text{CrO}_4{}^{2-} \\ \text{dichromate} \Rightarrow \text{Cr}_2\text{O}_7{}^{2-} \end{array}$



Naming Acids

- 1. Acids without oxygen:
 - a. Add prefix hydro to the anion's name
 - b. Change suffix to ic acid ex: HCN \Rightarrow hydrocyanic acid or $H_2S \Rightarrow$ hydrosulfuric acid
- 2. Acids with oxygen:

Change suffix of anion in the acid ate \Rightarrow ic acid ite \Rightarrow ous acid ex: $HNO_2 \Rightarrow$ nitrous acid vs. $HNO_3 \Rightarrow$ nitric acid

Naming Molecular Compounds

- 1. Add a Greek prefix to the first element's name when there's 2 or more
- 2. Always add a Greek prefix to the 2^{nd} element and change the suffix to –ide ex: $NF_3 \Rightarrow$ nitrogen trifluoride

Greek prefixes

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