Chemistry 1100 – Discussion
Assignment 3 – Hand in at the end of Discussion

Name Answer Key

Atomic Structure, Molecular and Ionic Compounds

I. *Mass Number and Atomic Number*

mass number → 202
atomic number → 80 **Hg**

Atomic number = number of protons
(Atomic # identifies the element as much as the element symbol does.)

Mass number = number of protons + number of neutrons
(Mass # can only be given for a *specific* isotope of an element.)

If the atom is neutral (charge = 0), # protons = # electrons.
(proton = (+), electron = (-), neutron = no charge)

II. *Atomic Mass*

- The average mass number of an element accounting for isotopic natural abundance percentages.
- Atomic mass is the number given in the periodic table.
- Atomic mass of an element = molar mass = g/mole for that element.

III. *Molecular and Ionic Compounds – Naming (IUPAC)*

- The first step is to determine if the compound is molecular or ionic.
- For naming simple binary <u>molecular</u> compounds (two nonmetals)
  a. Give the element with the lower group # first.
  b. The name of the element of higher group # is changed to end in "ide".
  c. Use numerical prefixes as neccessary.
  d. <u>Do not use</u> numerical prefixes for H + chalcogens/halogens.

  examples: N_2O_5 = dintrogen pentoxide
  H_2S = hydrogen sulfide, <u>not</u> dihydrogen monosulfide
  H_2O = water or hydrogen oxide, <u>not</u> dihydrogen monoxide

- For naming <u>ionic</u> compounds (metal + nonmetal)
  a. Give the element name of the cation (+) first.
  b. Give the name of the anion (-) second, change to end in "ide".
  c. If compound is composed of a polyatomic ion, use the name of the ion. (Table 2.3 in textbook)
  d. For transition metal cations, specify ionic charge with roman numerals.
  e. Numerical prefixes are <u>not used</u> for ionic compounds.

  examples: Al_2O_3 = aluminum oxide
  $Mg_3(PO_4)_2$ = magnesium phosphate
  Cu_2SO_4 = copper(I) sulfate (because Cu^{+1})
  $CuSO_4$ = copper(II) sulfate (because Cu^{+2})

IV. *Molecular and Ionic Compounds – Predicting Formulas*

- To predict the formula for a compound (ionic or molecular)
  a. Determine the likely oxidation state (charge) for each elemental "ion" or for polyatomic ion.
  b. Determine the least common multiple needed to give an overall neutral charge for the compound.
  example: beryllium + iodine → BeI_2 = beryllium iodide
  (Be^{2+}) (I^-)

Exercises

1. Match the scientist with his famous experiment/apparatus, and the discovery they made with it. (One scientist does not have a "famous" experiment.)

Scientist	Experiment/Apparatus	Discovery
James Chadwick	Au foil	electron
Robert Millikan	cathode ray tube	charge of the electron
J.J. Thomson	oil drop experiment	structure of the nucleus
Ernest Rutherford		neutron

a) Robert Millikan used the oil drop exp. to discover the charge of e^-.

b) JJ Thomson used the cathode ray tube to discover the electron.

c) Ernest Rutherford used the Au foil to discover the structure of the nucleus

d) James Chadwick discovered the neutron.

2. Give the atomic number, atomic mass and the number of protons, neutrons and electrons for each isotope.

a) ^{235}U atomic number 92 mass number 235

protons 92 neutrons 143 (235 - 92 = 143) electrons 92

b) ^{184}W atomic number 74 mass number 184

protons 74 neutrons 110 (184 - 74 = 110) electrons 74

3. What is the atomic mass (molar mass) of copper, if ^{63}Cu = 69.17% and ^{65}Cu = 30.83% natural abundance? (Assume ^{63}Cu = 63.00 g/mol, ^{65}Cu = 65.00 g/mol)

Atomic mass = (0.6917)(63.00 g/mol) + (0.3083)(65.00 g/mol)

= 43.58 g/mol + 20.04 g/mol

= **63.62 g/mol or amu**

4. Bromine has two stable isotopes (^{79}Br and ^{81}Br). If the atomic mass of Br is 79.904 g/mol, what is the percent abundance of ^{79}Br and ^{81}Br?
(Assume atomic mass of ^{79}Br =79.00 g/mol and ^{81}Br = 81.00 g/mol.)

2 unknowns: % ^{79}Br = X, % ^{81}Br = Y

need 2 equations: 79.904 g/mol = X(79.00 g/mol) + Y(81.00 g/mol), X + Y = 1

79.904 g/mol = X(79.00 g/mol) + (1-X)(81.00 g/mol)

79.904 g/mol = 79.00 g/mol (X) + 81.00 g/mol - 81.00 g/mol (X)

2.00 g/mol (X) = 1.096 g/mol

$X = \frac{1.096\ g/mol}{2.00\ g/mol} = 0.548$, ∴ **% ^{79}Br = 54.8%**

(∴ Y = 1-X)

Y = 1-X = 1-0.548

Y = 0.452

∴ **% ^{81}Br = 45.2%**

5. Give the IUPAC name of the following compounds.

a) H_2Te hydrogen telluride

b) $ZnCl_2$ Zinc chloride

c) $Ba(NO_3)_2$ barium nitrate

d) Fe_2O_3 iron (III) oxide

e) CO Carbon monoxide

6. Give the simplest formula and the IUPAC name of the compound resulting from each pair of elements/ions.

	I^-	CN^-	PO_4^{3-}	HCO_3^-	OH^-	SO_4^{2-}	NO_3^-
Co^{3+}	CoI_3 cobalt(III) iodide	$Co(CN)_3$ cobalt(III) cyanide	$CoPO_4$ cobalt(III) phosphate	$Co(HCO_3)_3$ cobalt(III) bicarbonate	$Co(OH)_3$ cobalt(III) hydroxide	$Co_2(SO_4)_3$ cobalt(III) sulfate	$Co(NO_3)_3$ cobalt(III) nitrate
Co^{2+}	CoI_2 cobalt(II) iodide	$Co(CN)_2$ cobalt(II) cyanide	$Co_3(PO_4)_2$ cobalt(II) phosphate	$Co(HCO_3)_2$ cobalt(II) bicarbonate	$Co(OH)_2$ cobalt(II) hydroxide	$CoSO_4$ cobalt(II) sulfate	$Co(NO_3)_2$ cobalt(II) nitrate
Na	NaI sodium iodide	$NaCN$ sodium cyanide	Na_3PO_4 sodium phosphate	$NaHCO_3$ sodium bicarbonate	$NaOH$ sodium hydroxide	Na_2SO_4 sodium sulfate	$NaNO_3$ sodium nitrate
Mn^{6+}	MnI_6 manganese(VI) iodide	$Mn(CN)_6$ manganese(VI) cyanide	$Mn(PO_4)_2$ manganese(VI) phosphate	$Mn(HCO_3)_6$ manganese(VI) bicarbonate	$Mn(OH)_6$ manganese(VI) hydroxide	$Mn(SO_4)_3$ manganese(VI) sulfate	$Mn(NO_3)_6$ manganese(VI) nitrate
Al	AlI_3 aluminum iodide	$Al(CN)_3$ aluminum cyanide	$AlPO_4$ aluminum phosphate	$Al(HCO_3)_3$ aluminum bicarbonate	$Al(OH)_3$ aluminum hydroxide	$Al_2(SO_4)_3$ aluminum sulfate	$Al(NO_3)_3$ aluminum nitrate
Sn^{4+}	SnI_4 tin(IV) iodide	$Sn(CN)_4$ tin(IV) cyanide	$Sn_3(PO_4)_4$ tin(IV) phosphate	$Sn(HCO_3)_4$ tin(IV) bicarbonate	$Sn(OH)_4$ tin(IV) hydroxide	$Sn(SO_4)_2$ tin(IV) sulfate	$Sn(NO_3)_4$ tin(IV) nitrate
NH_4^+	NH_4I ammonium iodide	NH_4CN ammonium cyanide	$(NH_4)_3PO_4$ ammonium phosphate	NH_4HCO_3 ammonium bicarbonate	NH_4OH ammonium hydroxide	$(NH_4)_2SO_4$ ammonium sulfate	NH_4NO_3 ammonium nitrate
Fe^{3+}	FeI_3 iron(III) iodide	$Fe(CN)_3$ iron(III) cyanide	$FePO_4$ iron(III) phosphate	$Fe(HCO_3)_3$ iron(III) bicarbonate	$Fe(OH)_3$ iron(III) hydroxide	$Fe_2(SO_4)_3$ iron(III) sulfate	$Fe(NO_3)_3$ iron(III) nitrate