South Pasadena • AP Chemistry

Name _____
Period ___ Date ___/___/___

3 • Molecules and Compounds

Station 1 – NAMING COMPOUNDS FROM FORMULAS

Name the following compounds:

Formula	Name
BF_3	**boron trifluoride (nonmetal compound)**
SF_6	**sulfur hexafluoride (nonmetal compound)**
$(NH_4)_2Cr_2O_7$	**ammonium dichromate (ionic compound)**
$PbCO_3$	**lead carbonate (ionic compound)**
NI_3	**nitrogen triiodide (nonmetal compound)**

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Station 2 – WRITING FORMULAS FROM NAMES

Write the formulas for the following compounds:

Name	Formula
Dinitrogen pentoxide	**N_2O_5**
ionic Aluminum oxide **Al^{3+} O^{2-}**	**Al_2O_3**
ionic Stannic sulfate **Sn^{4+} SO_4^{2-}**	**$Sn(SO_4)_2$**
Oxygen difluoride	**OF_2**
Carbon tetrachloride	**CCl_4**

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Station 3 – MINI MEGA-ION QUIZ

Fill in the symbol and charge for each of the following ions:

ferric	Fe^{3+}	sulfite	SO_3^{2-}	hydronium	H_3O^+
permanganate	MnO_4^-	silver	Ag^+	hydroxide	OH^-
sulfide	S^{2-}	thiosulfate	$S_2O_3^{2-}$	cupric	Cu^{2+}
phosphate	PO_4^{3-}	hypoiodite	IO^-	mercurous	Hg_2^{2+}
calcium	Ca^{2+}	nickel	Ni^{2+}	cyanide	CN^-

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Station 4 – MYSTERY IONS

Use your knowledge of ions and a little logic to answer the following questions:

Sodium arsenide has the formula: Na_3As. What is the formula for magnesium arsenide? ___Mg_3As_2___

Na^+ ∴ As^{3-} Mg^{2+} As^{3-}

Gold sulfide has the formula: Au_2S_3. What is the formula for gold chloride? ___$AuCl_3$___

S^{2-} ∴ Au^{3+} Au^{3+} Cl^-

Calcium oxalate has the formula: CaC_2O_4. What is the formula for aluminum oxalate? __$Al_2(C_2O_4)_3$___

Ca^{2+} ∴ $C_2O_4^{2-}$ Al^{3+} $C_2O_4^{2-}$

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Station 5 – % COMPOSITION

Use your periodic table and calculator to determine the % composition (by mass) of each element in:
Note: Give your answers to 1 decimal place.

Formula	%Ca	%C	%N
$Ca(CN)_2$	$\frac{40.08}{92.12} \times 100 = \mathbf{43.5\%}$	$\frac{24.02}{92.12} \times 100 = \mathbf{26.1\%}$	$\frac{28.02}{92.12} \times 100 = \mathbf{30.4\%}$

Calculation Area:

Ca **40.08 g**
C_2 **24.02 g**
N_2 **28.02 g**
92.12 g

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Station 6 – EMPIRICAL FORMULA FROM % COMPOSITION

Determine the empirical formula of the compound from the following %composition (by mass) information:

A compound composed of carbon and hydrogen is found to contain 85.6% C and 14.4% hydrogen by mass.

What is the empirical formula of the compound? ___**CH_2**____

Calculation Area:
Assume 100 g of compound.

85.6 g C x $\frac{\text{1 mole C}}{\text{12.01 g C}}$ **= 7.13 mol C**

14.4 g H x $\frac{\text{1 mole H}}{\text{1.01 g H}}$ **= 14.26 mol H**

$\frac{7.13}{7.13}$ **= 1 C**

$\frac{14.26}{7.13}$ **= 2 H**

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Station 7 – MOLE PROBLEMS

Solve the following problems. Show your work using dimensional analysis:

A 2.00 Liter bottle is filled with XeF_4 gas. What is the mass of the gas sample? [MM XeF_4 = 207.30 g/mol]

$$2.00\ \text{L} \times \frac{1\ \text{mole XeF}_4}{22.4\ \text{L}} \times \frac{207.30\ \text{g}}{1\ \text{mole XeF}_4} = 18.5\ \text{g XeF}_4$$

How many molecules of CO_2 make up a 5.25 g chunk of dry ice? [MM CO_2 = 44.01 g/mol]

$$5.25\ \text{g CO}_2 \times \frac{1\ \text{mole CO}_2}{44.01\ \text{g CO}_2} \times \frac{6.023 \times 10^{23}\ \text{molecules}}{1\ \text{mole CO}_2} = 7.18 \times 10^{22}\ \text{molecules CO}_2$$

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Station 8 – IDENTIFY MYSTERY SUBSTANCE

When asked to identify a mystery compound, it is often useful to determine the <u>molar mass</u> of the substance. Use the following information to identify the mystery substance:

A 1.25 Liter sample of a diatomic gas, measured at STP, has a mass of 3.96 grams.
What is the identity of the gas? _____

$$\frac{x}{22.4\ \text{L}} = \frac{3.96\ \text{g}}{1.25\ \text{L}} \qquad x = 70.96\ \text{g/mol} \qquad \text{Cl}_2$$

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Station 9 – HYDRATE LAB

A student is assigned the task of determining the number of moles of water in one mole of $MgCl_2 \cdot n\ H_2O$. The student collects the data shown in the following table.

Mass of empty container	22.347 g
Initial mass of sample and container	25.825 g
Mass of sample and container after first heating	23.982 g
Mass of sample and container after second heating	23.976 g
Mass of sample and container after third heating	23.977 g

Determine the ***moles of water lost*** when the sample was heated.

$25.825\ g - 23.977\ g = 1.848\ g\ H_2O$

$$1.848\ g \times \frac{1\ mole\ H_2O}{18.02\ g} = 0.1026\ mole\ H_2O$$

Determine the ***formula*** of the hydrated compound.

$23.977\ g - 22.347\ g = 1.630\ g\ MgCl_2$

$$1.630\ g\ MgCl_2 \times \frac{1\ mole\ MgCl_2}{95.20\ g} = 0.01712\ mol\ MgCl2$$

Mole Ratio: $MgCl_2 : H_2O$

$$\frac{0.01712}{0.01712} : \frac{0.1026}{0.01712} = 1:5.99$$

$MgCl_2 \cdot 6\ H_2O$