###### Unit 6: The Mathematics of Chemical Formulas Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| **# of H2O molecules** | **# of H atoms** | **# of O atoms** |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 100 |  |  |
| 6.02 x 1023 |  |  |

|  |  |  |
| --- | --- | --- |
|  |  |  |

molar mass:

**PbO2** **HNO3**

**ammonium** **phosphate**

percentage composition: the mass % of each element in a compound



Find % composition.

**PbO2**

**(NH4)3PO4**

**zinc acetate**

Finding an Empirical Formula from Experimental Data

1. Find # of g of each element.

2. Convert each g to mol.

3. Divide each “# of mol” by the smallest “# of mol.”

4. Use ratio to find formula.

A compound is 45.5% yttrium and 54.5% chlorine. Find its empirical formula.

A ruthenium/sulfur compound is 67.7% Ru. Find its empirical formula.

A 17.40 g sample of a technetium/oxygen compound contains 11.07 g of Tc. Find the empirical formula.

A compound contains 4.63 g lead, 1.25 g nitrogen, and 2.87 g oxygen. Name the compound.

To find molecular formula… A. Find empirical formula.

B. Find molar mass of empirical formula.

 C. Find n = mm molecular

mm empirical

 D. Multiply all parts of empirical formula by n.

A carbon/hydrogen compound is 7.7% H and has a molar mass of 78 g. Find its molecular formula.

A compound has 26.33 g nitrogen, 60.20 g oxygen, and molar mass 92 g. Find molecular formula.

**MOLE**

**(mol)**

Mass

**(g)**

Particle

**(atoms)**

1 mol = molar mass (in g)

Volume

**(L or dm3)**

1 mol = 22.4 L

1 mol = 22.4 dm3

Mole Calculations

New Points about Island Diagram:

a. Diagram now has four islands.

b. “Mass Island” now for elements or compounds

c. “Particle Island” now for atoms or molecules

1 mol = 6.02 x 1023 particles

d. “Volume Island”: for gases only

 1 mol @ STP = 22.4 L = 22.4 dm3

What mass is 1.29 mol ferrous nitrate?

How many molecules is 415 L sulfur dioxide at STP?

What mass is 6.29 x 1024 m’cules aluminum sulfate?

At STP, how many g is 87.3 dm3 of nitrogen gas?

How many m’cules is 315 g of iron (III) hydroxide?

How many atoms are in 145 L of CH3CH2OH at STP?

Hydrates and Anhydrous Salts

anhydrous salt: an ionic compound (i.e., a salt) that attracts water molecules and forms loose

chemical bonds with them; symbolized by MN

 “anhydrous” = “without water”

 Uses:

hydrate: an anhydrous salt with the water attached

 -- symbolized by MN **.** ? H2O

 Examples:

**H2O**

**H2O**

**H2O**

**H2O**

###### MN

###### MN

**+**

**HEAT**

**H2O**

**H2O**

**H2O**

**H2O**

**H2O**

**H2O**

**H2O**

**H2O**

hydrate anhydrous salt water

Finding the Formula of a Hydrate

1. Find the # of g of MN and # of g of H2O.

2. Convert g to mol.

3. Divide each “# of mol” by the smallest “# of mol.”

4. Use the ratio to find the hydrate’s formula.

Find formula of hydrate for each problem.

sample’s mass before heating = 4.38 g

sample’s mass after heating = 1.93 g

molar mass of anhydrous salt = 85 g

A. beaker = 46.82 g

B. beaker + sample before heating = 54.35 g

C. beaker + sample after heating = 50.39 g

 molar mass of anhydrous salt = 129.9 g

A. beaker = 47.28 g

B. beaker + sample before heating = 53.84 g

C. beaker + sample after heating = 51.48 g

 molar mass of anhydrous salt = 128 g

Find % water and % anhydrous salt (by mass).

## Review Problems

Find % comp. of iron (III) chloride.

A compound contains 70.35 g C and 14.65 g H. Its molar mass is 58 g. Find its molecular formula.

At STP, how many g is 548 L of chlorine gas?

Strontium chloride is an anhydrous salt beaker = 65.2 g

on which the following data were beaker + sample before heating = 187.9 g

collected. Find formula of hydrate. beaker + sample after heating = 138.2 g