Name: Key

Student #: _____
Regents Chemistry

Moles and Stoichiometry Exam Review Stations Activity

Station 1: Gram-formula mass

1. What is the molar mass (gram-formula mass) of $Fe(C_2H_3O_2)_3$?

Fe: 1 × 55.8 = 55.8
C: 6 × 12.0 = 72.0
H: 9 × 1.0 = 9.0
O: 6 × 16.0 = +96.0
232.8 g/mol

2. What is the gram-formula mass of $Ca_3(PO_4)_2$?

Ca: 3 × 40.1 = 120.3
P: 2 × 31.0 = 62.0
O: 8 × 16.0 = +128.0
310.g/mol

3. A 1.0-mole sample of krypton gas has a mass of 83.8 g/mol.

Kr — 83.8 g/mol
* molar mass is the mass of 1 mole of a substance

4. Calculate the gram-formula mass for the hydrate, $BaCl_2 \cdot 2H_2O$.

Ba: 1 × 137.3 = 137.3
Cl: 2 × 35.5 = 71.0
H_2O: 2 × 18.0 = +36.0
244.3 g/mol

5. Calculate the gram-formula mass of Fe_2O_3.

Fe: 2 × 55.8 = 111.6
O: 3 × 16.0 = 48.0
159.6 g/mol

Station 2: Mole calculations

moles = given mass / gram-formula mass

1. How many moles of NaOH are represented by 210 grams of NaOH?

moles = 210 g / 40.0 g/mol = 5.25 moles

↳ gfm = Na: 1 × 23.0 = 23.0
O: 1 × 16.0 = 16.0
H: 1 × 1.0 = 1.0
40.0 g/mol

2. What is the mass of 0.02 moles of CO_2?

0.02 mol = x / 44.0 g/mol
x = 0.88 g

↳ gfm = C: 1 × 12.0 = 12.0
O: 2 × 16.0 = 32.0
44.0 g/mol

3. How many moles are in 60.0 grams of $Ca(NO_3)_2$?

moles = 60.0 g / 164.1 g/mol = 0.3660 mol

↳ gfm = Ca: 1 × 40.1 = 40.1
N: 2 × 14.0 = 28.0
O: 6 × 16.0 = 96.0
164.1 g/mol

4. How many grams are in 12 moles of P_2O_5?

12 mol = x / 142.0 g/mol
x = 1704 g

↳ gfm = P: 2 × 31.0 = 62.0
O: 5 × 16.0 = 80.0
142.0 g/mol

5. Calculate the number of moles of molecules in a 12.0-gram sample of Cl_2.

moles = 12.0 g / 71.0 g/mol = 0.169 moles

↳ gfm: 2 × 35.5 = 71.0
g/mol

% composition = $\frac{\text{mass of part}}{\text{mass of whole}} \times 100\%$

Station 3: Percent composition

1. What is the percent composition by mass of hydrogen in NH_4HCO_3 (gram-formula mass = 79 grams/mole)?

H: $5 \times 1.0 = 5.0$

$\%\ H = \frac{\text{mass H}}{\text{mass of compound}} \times 100\% = \frac{5.0}{79} \times 100\% = 6.33\%$

2. Find the percent of carbon in each of the following:

a. C_3H_8

gfm:
C: $3 \times 12.0 = 36.0$
H: $8 \times 1.0 = 8.0$
44.0 g/mol

$\%\ C = \frac{36.0}{44.0} \times 100\% = 81.8\%$

b. CO_2

gfm:
C: $1 \times 12.0 = 12.0$
O: $2 \times 16.0 = 32.0$
44.0 g/mol

$\%\ C = \frac{12.0}{44.0} \times 100\% = 27.3\%$

3. A 4.4 gram sample of a hydrate was heated until the water of hydration was driven off. The anhydrous compound remaining had a mass of 3.3 grams. What is the percentage by mass of water in the hydrate?

mass $H_2O = 4.4 - 3.3 = 1.1$ g

% composition water in a hydrate = $\frac{\text{mass of attached water molecules}}{\text{mass of hydrate}} \times 100\% = \frac{1.1\text{ g}}{4.4\text{ g}} \times 100\% = 25\%$

4. A hydrate is a compound with water molecules incorporated into its crystal structure. In an experiment to find the percent by mass of water in a hydrated compound, the following data were recorded:

What is the percent by mass of water in the hydrate?

Mass of crucible + hydrated crystals before heating	7.50 grams
Mass of crucible	6.90 grams
Mass of crucible + anhydrous crystals after heating	7.20 grams

Mass H_2O = 7.50 − 7.20 = 0.3g

mass hydrate = 7.50 − 6.90 = 0.6g

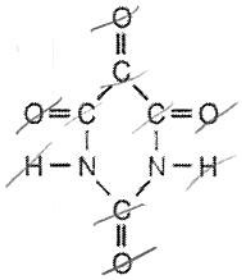
$\%\ \text{water} = \frac{\text{mass } H_2O}{\text{mass hydrate}} \times 100\% = \frac{0.3\text{g}}{0.6\text{g}} \times 100\% = 50\%$

5. The percent by mass of nitrogen in $Mg(CN)_2$ is equal to 36.7%.

gfm: Mg: $1 \times 24.3 = 24.3$
C: $2 \times 12.0 = 24.0$
N: $2 \times 14.0 = 28.0$
76.3 g/mol

$\%\ N = \frac{28.0}{76.3} \times 100\% = 36.7\%$

Station 4: Empirical & Molecular formulas



1. Given the structural formula for a compound:
   Write the molecular formula and empirical formula to represent this compound.
   - molecular: $C_4H_2O_4N_2$ (÷2 ÷2 ÷2 ÷2)
   - empirical: C_2HO_2N

2. Write the corresponding empirical formulas for the following molecular formulas:
   a) P_4O_{10}: P_2H_5
   b) $C_6H_{12}O_6$: CH_2O
   c) SO_2: SO_2
   d) $C_4H_8O_4$: CH_2O
   e) $CH_3CH_2COOCH_3$: $C_4H_8O_2 \rightarrow C_2H_4O$
   f) CH_4: CH_4
   g) C_6H_6: CH

3. A compound has a molecular mass of 54 and an empirical formula of C_2H_3. What is the molecular formula of the compound?

$\frac{\text{molecular mass}}{\text{empirical mass}} = \frac{54}{27} = 2$

C_2H_3 (×2 ×2) $\Rightarrow C_4H_6$

empirical mass =
- C: 2 × 12.0 = 24.0
- H: 3 × 1.0 = 3.0

27.0

. A compound has the empirical formula CH_2O and a gram-formula mass of 60. grams per mole. What is the molecular formula of this compound?

empirical mass of CH_2O:
- C: 1 × 12.0 = 12.0
- H: 2 × 1.0 = 2.0
- O: 1 × 16.0 = 16.0

30.0

$\frac{\text{molecular mass}}{\text{empirical mass}} = \frac{60}{30} = 2$

CH_2O (×2 ×2 ×2) = $C_2H_4O_2$

5. A compound has an empirical formula of HCO_2 and a molecular mass of 90. grams per mole. What is the molecular formula of this compound?

empirical mass of HCO_2:
- H: 1 × 1.0 = 1.0
- C: 1 × 12.0 = 12.0
- O: 2 × 16.0 = 32.0

45.0

$\frac{\text{molecular mass}}{\text{empirical mass}} = \frac{90}{45} = 2$

HCO_2 (×2 ×2 ×2) = $H_2C_2O_4$

Station 5: Mole-Mole Ratios

1. Given the balanced equation representing a reaction:

$$F_2\ (g) + H_2\ (g) \rightarrow 2\ HF\ (g)$$

What is the mole ratio of H_2 (g) to HF (g) in this reaction?

1 : 2 or $\frac{1}{2}$

2. According to the following balanced equation:

$$2\ C_4H_{10}\ (g) + 13\ O_2\ (g) \rightarrow 8\ CO_2\ (g) + 10\ H_2O\ (g)$$

What is the total number of moles of O_2 (g) that must react completely with 5.00 moles of C_4H_{10} (g)?

wanted

given

$\frac{\text{given moles}}{\text{coefficient}} = \frac{\text{wanted moles}}{\text{coefficient}}$

$\frac{C_4H_{10}}{5.00} = \frac{O_2}{x}$

$\frac{5.00}{2} = \frac{x}{13}$

$2x = 65$

$x = 32.5$ moles O_2

3. Given the balanced equation representing a reaction:

$$2\ C_2H_6\ (g) + 7\ O_2\ (g) \rightarrow 4\ CO_2\ (g) + 6\ H_2O\ (g)$$

What is the total number of moles of CO_2 (g) produced by the complete combustion of 5.0 moles of C_2H_6 (g)?

wanted

given

$\frac{\text{given moles}}{\text{coefficient}} = \frac{\text{wanted moles}}{\text{coefficient}}$

$\frac{C_2H_6}{5.0} = \frac{CO_2}{x}$

$\frac{5.0}{2} = \frac{x}{4}$

$2x = 20$

$x = 10$ moles CO_2

4. Balance the following equation:

$$\_1\_\ H_2\ (g) + \_1\_\ Cl_2\ (g) \rightarrow \_2\_\ HCl\ (g)$$

wanted

given

What is the total number of moles of HCl (g) produced when 3 moles of H_2 (g) is completely consumed?

given moles / coefficient = wanted moles / coefficient

$\frac{H_2}{3\text{ moles}} = \frac{HCl}{x}$

$\frac{3}{1} = \frac{x}{2}$

$x = 6$ moles HCl

5. Balance the following equation:

$$\_2\_\ C + \_3\_\ H_2 \rightarrow \_1\_\ C_2H_6$$

wanted

given

What is the total number of moles of C that must completely react to produced 2.0 moles of C_2H_6?

given moles / coefficient = wanted moles / coefficient

$\frac{C_2H_6}{2.0\text{ moles}} = \frac{C}{x}$

$\frac{2.0}{1} = \frac{x}{2}$

$x = 4.0$ moles C