

Review Assignment: The Mole

1. a) The molar mass of aluminum nitrate nonahydrate, $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ is:

375.15 g/mol

b) The number of moles of oxygen in 3.0 moles of aluminum nitrate nonahydrate, $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, is:

54 moles

c) The number of oxygen atoms present in 0.153 mol of dinitrogen trioxide, N_2O_3 :

2.76×10^{23} atoms

$$n_{\text{O}} = 0.153 \times 3 = 0.459 \text{ mol}$$

$$N_{\text{O}} = 0.459 \times N_{\text{A}}$$

d) The number of molecules of water in 1.25 mol H_2O is:

7.53×10^{23} molecules

e) If the molar mass of an unknown substance is found to be 56.2 g/mol, the mass of 2.5 mol of the substance is:

140 g

f) The number of moles of ethane, C_2H_6 , in 72.1 g is:

2.40 mol

g) The percent of nitrogen, by mass, in N_2O_3 is:

36.86% N

h) The mass of nitrogen in 34 g of N_2O_3 is:

13 g

i) The percent water in $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$

44.90%

j) The mass of one atom of nitrogen in grams is:

$2.327 \times 10^{-23} \text{ g}$

k) A compound has a molar mass of 144.98 g/mol and an empirical formula of $\text{C}_4\text{H}_8\text{O}$.

The compound's molecular formula is:

$\text{C}_8\text{H}_{16}\text{O}_2$

2. A 40.5 g sample of a compound is made up of 10.5 g of nitrogen and 30.0 g of oxygen. Determine the empirical formula of the compound.

$$n_{\text{N}} = 10.5/14.01 = 0.749 \text{ mol}$$

$$n_{\text{O}} = 30.0/16.00 = 1.88 \text{ mol}$$

$$0.749 \quad :$$

$$1.88$$

$$1$$

:

$$2.5$$

$$2$$

:

$$5$$

Therefore N_2O_5

3. A compound with a molar mass of 116.73 g/mol is found to contain 61.73% carbon and 10.36% hydrogen and 27.41% oxygen, by mass. Determine the molecular formula of the compound.

$$m_C = 0.6173 \times 116.73 \quad m_H = 0.1036 \times 116.73 \quad m_O = 0.2741 \times 116.73$$

$$= 72.06g \quad = 12.09g \quad = 32.00g$$

$$N_C = 72.06/12.01 \quad n_H = 12.09/1.008 \quad n_O = 32.00/16.00$$

$$= 6.000 \text{ mol} \quad = 11.99 \text{ mol} \quad = 2.000 \text{ mol}$$

Therefore $C_6H_{12}O_2$

4. Complete the following chart:

Formula	Name
$NiSO_4 \cdot 6H_2O$	Nickel (II) sulfate hexahydrate
$Fe_2S_3 \cdot 3H_2O$	Iron (III) sulfide trihydrate

5. A sample of a hydrated compound of $NaNO_3$ is massed, gently heated to remove the water and then remassed. Using the following data, calculate the % water of the hydrate and the "x" in the formula $NaNO_3 \cdot xH_2O$.

Mass before heating: 6.25 g

Mass after heating: 3.82 g

Mass of water: 2.43 g

$$\% \text{ water: } 2.43/6.25 \times 100\% = 38.9\%$$

	$NaNO_3$	H_2O
mass	3.82 g	2.43 g
moles	$3.82/85.00$ $= 0.04494 \text{ mol}$	$2.43/18.02$ $= 0.1349 \text{ mol}$
ratio	$0.04494/0.04494$ $= 1$	$0.1349/0.04494$ $= 3$
	1	3

Therefore "x" = 3

6. Determine the hydrated formula of copper (II) carbonate if the percent water is 50.52%.

$$\% \text{H}_2\text{O} = 50.52$$

$$\% \text{CuCO}_3 = 100 - 50.52 = 49.48\%$$

Assuming 100g sample:

	CuCO_3	H_2O
Mass	49.48 g	50.52 g
Moles	$49.48/123.56$ $= 0.4005 \text{ mol}$	$50.52/18.02$ 2.804 mol
Ratio	$0.4005/0.4005$ $= 1$	$2.804/0.4005$ $= 7$

Therefore the formula is $\text{CuCO}_3 \cdot 7\text{H}_2\text{O}$

7. Compare the following pairs of terms: we will discuss this in class

- a) Empirical formula, molecular formula
- b) Mole, molecule
- c) Atomic mass, molar mass
- d) Error, percent error

8. A water molecule contains one central oxygen atom and two hydrogen atoms. How many oxygen atoms in 2.2 moles of water?

a) 1.32×10^{24}

b) 1.32×10^{25}

c) 1.32×10^{23}

d) 6.02×10^{23}

9. Copper wire consists of copper atoms connected through metallic bonds. Find the moles of copper in 1.87×10^{24} copper atoms.

a) 1.00

b) 3.1

c) 3.11

d) 6.02×10^{23}

10. Tungsten is the metal used in most light bulb filaments. One filament contains around 0.018 grams of tungsten. The atomic mass of tungsten is 183.84 g/mol. How many moles of tungsten are in a light bulb filament?

a) 9.8×10^{-5}

b) 3.3

c) 1.1×10^{20}

d) 0.0054

11. Uranium is a radioactive metal that can be refined and used for nuclear power plants. The atomic mass of uranium is 238. How many uranium atoms are present in 1.00 kg of uranium?

a) 4.20

b) 6.02×10^{27}

c) 1.43×10^{27}

d) 2.53×10^{24}

12. How many moles of C_3H_8 are present in 451 g C_3H_8 ?

a) 3.84

b) 0.879

c) 10.2

d) 1.44

13. Calculate the number of moles of hydrogen atoms in 4.75 mol sulfuric acid.

a) 2.38

b) 4.75

c) 9.50

d) 33.2

14 Ethanol is C_2H_5OH . How many atoms of hydrogen are in 92 grams of ethanol?

a) 7.2×10^{24}

b) 1.2×10^{24}

c) 6.0×10^{24}

d) 3.0×10^{24}

15. What is the percent composition of carbon dioxide CO_2 ?

a) 73% C and 27% O

b) 27% C and 73% O

c) 33% C and 66% O

d) 50% C and

50% O

16. An empirical formula mass is found to be 17 g/mol. The molar mass is found to be 34 g/mol. What is the number of empirical formula units in this molar mass?

a) 2 units

b) 0.50 units

c) 17 units

d) 1 units

17. A sample of a metal salt contains 36.1 % calcium and 63.9 % chlorine. What is the empirical formula?

a) $CaCl$

b) Ca_2Cl_2

c) Ca_2Cl

d) $CaCl_2$

18. A compound that has a specific number of water molecules bound to the structure is

_____?

a) A hydrate

b) an anhydrate

c) aqueous

d) waterlogged

19. A sample is 50.7% $CaCl_2$ and 49.3 % H_2O . How many water molecules are associated with this hydrate?

a) 5

b) 6

c) 8

d) 10