KEY

The Mole

Name - _____

1.) You obtain the following results.

$11.1\ g$ of hydrogen gas reacts with $88.9\ g$ of oxygen gas.

$46.7\ g$ of nitrogen gas react with $53.3\ g$ of oxygen gas.

$42.9\ g$ of carbon react with $57.1\ g$ of oxygen gas.

Assuming a mass of "1" for hydrogen, calculate the relative mass of oxygen, nitrogen and carbon. (Don't be surprised if the values you calculate are not what you expect. Not all molecules involve 1:1 ratios, which was a problem for early chemists too).

Answer - Convert mass of hydrogen to being "1". $H = \frac{11.1}{11.1} = 1$

Convert all elements relative to hydrogen. $O = \frac{88.9}{11.1} = 8.01$

$N = \frac{46.7}{53.3} = 0.876 \times 8.01 = 7.01$ $C = \frac{42.9}{57.1} = 0.751 \times 8.01 = 6.02$

2.) If $1.0\ L$ of nitrogen gas reacts with $3.0\ L$ of chlorine gas when both gases are at the same temperature and pressure, how many chlorine molecules are present for every nitrogen molecule in the reaction? Suggest a formula for the compound formed and name the compound.

Answers - 3 chlorine for every 1 nitrogen

NCl_3 = nitrogen trichloride

3.) Experimentally it is found that $1.5\ L$ of gaseous sulphur reacts with $3.0\ L$ of gaseous oxygen at the same temperature and pressure. Suggest a possible formula and name the compound formed.

Answers - There is double oxygen to sulphur.

SO_2 = sulphur dioxide

4.) At room temperature and pressure, $250\ mL$ of chlorine gas react completely with $750\ mL$ of fluorine gas. Suggest a possible formula and name for the compound formed in the reaction.

Answers - There is triple the amount of fluorine to chlorine.

ClF_3 = chlorine trifluoride

KEY

5.) If $1.0\ L$ of unknown gas X contains $3.0 \times 10^{23}\ molecules$ at a certain temperature and pressure, how many molecules are present in $5.0\ L$ of oxygen gas at the same temperature and pressure?

Answer - $5.0\ L \times \frac{3.0 \times 10^{23} molec}{1.0\ L} = 1.5 \times 10^{24}\ molecules$

6.) Calculate the molar mass of each of the following.

a.) NO $(1 \times 14.01) + (1 \times 16.00) = 30.01\ g$

b.) H_2O $(2 \times 1.01) + (1 \times 16.00) = 18.02\ g$

c.) NH_3 $(1 \times 14.01) + (3 \times 1.01) = 17.04\ g$

d.) CO_2 $(1 \times 12.01) + (2 \times 16.00) = 44.01\ g$

e.) CH_4 $(1 \times 12.01) + (4 \times 1.01) = 16.05\ g$

f.) $AgNO_3$ $(1 \times 107.87) + (1 \times 14.01) + (3 \times 16.00) = 169.88\ g$

g.) $Ca(OH)_2$ $(1 \times 40.08) + (2 \times 16.00) + (2 \times 1.01) = 74.10\ g$

h.) $Al(NO_3)_3$ $(1 \times 26.98) + (3 \times 14.01) + (9 \times 16.00) = 213.0\ g$

i.) $FeCl_3$ $(1 \times 55.85) + (3 \times 35.45) = 162.2\ g$

j.) SnC_2O_4 $(1 \times 118.71) + (2 \times 12.01) + (4 \times 16.00) = 206.73\ g$

k.) $Sn(C_2O_4)_2$ $(1 \times 118.71) + (4 \times 12.01) + (8 \times 16.00) = 294.75\ g$

l.) $(NH_4)_3PO_4$ $149.12\ g$

m.) CH_3COOH $60.06\ g$

n.) $CH_3CH_2CH_2CH_3$ $58.14\ g$

o.) $Ni(H_2O)_2(NH_3)_4Cl_2$ $233.79\ g$

p.) $Al_2(SO_4)_3$ $342.1\ g$

7.) Calculate the molar mass of each of the following.

a.) $Co_3(AsO_4)_2 \cdot 8H_2O$

Answer - $(3 \times 58.93) + (2 \times 74.92) + (8 \times 16.00) + (16 \times 1.01) + (8 \times 16.00) = 598.8\ g$

b.) $Pb(C_2H_3O_2)_2 \cdot 3H_2O$

Answer - $(1 \times 207.20) + (4 \times 12.01) + (6 \times 1.01) + (4 \times 16.00) + (6 \times 1.01) + (3 \times 16.00) = 379.4\ g$

c.) $MgSO_4 \cdot 7H_2O$

Answer - $(1 \times 24.31) + (1 \times 32.06) + (4 \times 16.00) + (14 \times 1.01) + (7 \times 16.00) = 246.5\ g$

d.) $KAl(SO_4)_2 \cdot 12H_2O$

Answer - $(1 \times 39.01) + (1 \times 26.98) + (2 \times 32.06) + (8 \times 16.00) + (24 \times 1.01) + (12 \times 16.00) = 474.4\ g$