KEY

Molecular Formula

Name - _____

1.) A gas has the empirical formula CH_2. If $0.850\ L$ of the gas at STP has a mass $of\ 1.59\ g$, what is the molecular formula?

Answers - $\frac{1.59\ g}{0.850\ L} \times \frac{22.4\ L}{1\ mol} = \frac{41.90\ g}{1\ mol}$ $\frac{molar\ mass}{E.F.mass} = \frac{41.90\ g}{14.03\ g} = 2.99 \approx 3 \rightarrow C_3H_6$

2.) A gas has the percentage composition: 30.4% N and 69.6% O. If the density of the gas is $4.11\frac{g}{L}$, at STP, what is the molecular formula of the gas?

Answers - $30.4\ g\ N \times \frac{1\ mol\ N}{14.01\ g\ N} = 2.17\ mol\ N\ atoms$ $69.6\ g\ O \times \frac{1\ mol\ O}{16.00\ g\ O} = 4.35\ mol\ O\ atoms$

$\frac{2.17\ mol\ N}{2.17} = 1.00\ mol\ N$ $\frac{4.35\ mol\ O}{2.17} = 2.00\ mol\ O$ 1N : 2O = NO_2 (E.F.)

$\frac{4.11\ g}{1\ L} \times \frac{22.4\ L}{1\ mol} = \frac{92.06\ g}{1\ mol}$ $\frac{molar\ mass}{E.F.mass} = \frac{92.06\ g}{46.01\ g} = 2.00 \rightarrow N_2O_4$

3.) A compound has an empirical formula C_5H_{11}. If $0.0275\ mol$ of the compound has a mass of $3.91\ g$, what is the molecular formula of the compound?

Answers - $\frac{3.91\ g}{0.0275\ mol} = \frac{142.18g}{1\ mol}$ $\frac{molar\ mass}{E.F.mass} = \frac{142.18\ g}{71.16\ g} = 1.99 \approx 2 \rightarrow C_{10}H_{22}$

4.) When a sample of nickel carbonyl is heated, $0.0600\ mol$ of a gas containing carbon and oxygen is formed. The gas has a mass of $1.68\ g$ and is 42.9% C. What is the molecular formula of the gas?

Answers - $42.9\ g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} = 3.57\ mol\ C\ atoms$ $57.1\ g\ O \times \frac{1\ mol\ O}{16.0\ g\ O} = 3.57\ mol\ O\ atoms$

$\frac{3.57\ mol\ N}{3.57} = 1.00\ mol\ C$ $\frac{3.57\ mol\ O}{3.57} = 1.00\ mol\ O$ 1C : 1O = CO (E.F.)

$\frac{1.68\ g}{0.0600\ mol} = \frac{28.0\ g}{1\ mol}$ $\frac{molar\ mass}{E.F.mass} = \frac{28.0\ g}{28.01\ g} = 1 \rightarrow CO$

KEY

5.) A gas sample is analysed and found to contain 33.0% Si and 67.0% F. If the gas density is $7.60\frac{g}{L}$ at STP, what is the molecular formula of the gas?

Answers - $33.0\ g\ Si \times \frac{1\ mol\ Si}{28.09\ g\ Si} = 1.17\ mol\ Si\ atoms$ $\quad 67.0\ g\ F \times \frac{1\ mol\ F}{19.00 g\ F} = 3.53\ mol\ F\ atoms$

$\frac{1.17\ mol\ Si}{1.17} = 1\ mol\ Si$ $\quad \frac{3.53\ mol\ F}{1.17} = 3\ mol\ F$ $\quad$ 1Si : 3F = SiF_3 (E.F.)

$\frac{7.60\ g}{1\ L} \times \frac{22.4\ L}{1\ mol} = \frac{170.24\ g}{1\ mol}$ $\quad \frac{molar\ mass}{E.F.mass} = \frac{170.24\ g}{85.09\ g} = 2.0 \rightarrow$ Si_2F_6

6.) A gas has the percentage composition: 78.3% B and 21.7% H. A sample bulb is filled with the unknown gas and weighed. The mass of unknown gas is found to be $0.986\ times$ the mass of a sample of nitrogen gas in the same bulb under the same conditions of temperature and pressure. What is the molecular formula of the unknown gas?

Answers - $78.3\ g\ B \times \frac{1\ mol\ B}{10.81\ g\ B} = 7.24\ mol\ B\ atoms$ $\quad 21.7\ g\ H \times \frac{1\ mol\ H}{1.01 g\ H} = 21.5\ mol\ H\ atoms$

$\frac{7.24\ mol\ B}{7.24} = 1\ mol\ B$ $\quad \frac{21.5\ mol\ H}{7.247} = 2.97\ mol\ H$ $\quad$ 1B : 3H = BH_3 (E.F.)

$0.986 \times 28.02\ g\ N_2 = 27.63\ g$ $\quad \frac{molar\ mass}{E.F.mass} = \frac{27.63\ g}{13.84\ g} = 2.0 \rightarrow$ B_2H_6

7.) A gas has an empirical formula CH_2. $If\ 0.500\ L$ of the gas at STP has a mass of $0.938\ g$, what is the molecular formula of the compound?

Answers - $\frac{0.938\ g}{0.500\ L} \times \frac{22.4\ L}{1\ mol} = \frac{42.02\ g}{1\ mol}$ $\quad \frac{molar\ mass}{E.F.mass} = \frac{42.02\ g}{14.03\ g} = 2.99 \approx 3 \rightarrow$ C_3H_6

8.) A sample of gas has an empirical formula of O and a molar mass which is 3 times that of CH_4. What is the molecular formula of the gas?

Answer - $3 \times 16.05\ g\ CH_4 = 48.15\ g$ $\quad \frac{molar\ mass}{E.F.mass} = \frac{48.15\ g}{16.00\ g} = 3$ $\quad O_3$