① Mole ⇒ N_A Unit

② Molar mass ⇒ mass of N_A unit in gm

③ Molecular mass = $\frac{\text{mass of 1 molecule}}{\frac{1}{12}\text{th mass of 1 atom of C-12}}$ = Unitless

or

Atomic mass

④ Avg molar mass = $\frac{\text{Total mass}}{\text{Total mole}} = \frac{n_1M_1 + n_2M_2}{n_1 + n_2}$

⑤ Density → Absolute ⇒ $d = \left(\frac{m}{V}\right)$

→ Relative ⇒ $d_{rel} = \left(\frac{d_1}{d_2}\right)$

① V.D = $\frac{d_{Gas}}{d_{H_2\,Gas}}$ Under same P, T

$$V.D. = \frac{M_{Gas}}{2}$$

② Sp gravity = $\frac{d_{Substance}}{d_{H_2O}\text{ at }4^\circ C}$

Sp gravity = $d_{Substance}$ (gm/ml)

Basic moles:

Total number of electrons present in 4.4 g oxalate ion ($C_2O_4^{2-}$) is

(a) $0.05N_A$
(b) $2.3N_A$
(c) $2.2N_A$
(d) $2.1N_A$

$\left(\frac{4.4}{88}\right) N_A \times 46 e^- = 2.3 N_A$

$C_2O_4^{-2}$

$12 + 32 + 2 = 46$

Total number of valence electrons present in 6.4 g peroxides ion (O_2^{2-}) is

(a) $0.2N_A$
(b) $3.2N_A$
(c) $3.6N_A$
(d) $2.8N_A$

$\left(\frac{6.4}{32}\right)^{0.2} \times N_A \times 14 = 2.8 N_A$

$O_2^{-2} = 12 + 2 = 14$

A compound contains 7 carbon atoms, 2 oxygen atoms and 9.96×10^{-24} g of other elements. The molecular mass of compound is ($N_A = 6 \times 10^{23}$)

(a) 122
(b) 116
(c) 148
(d) 154

$1\,amu = \frac{1}{N_A}\,gm$
$= \frac{1}{12}$th mass of 1 atom of C-12

$7 \times 12 + 2 \times 16 + 9.96 \times 10^{-24} \times 6 \times 10^{23}$
$= 84 + 32 + 5.976$
$\simeq 122$

The volume of one mole of water at 277 K is 18 ml. One ml of water contains 20 drops. The number of molecules in one drop of water will be ($N_A = 6 \times 10^{23}$)

(a) 1.07×10^{21}
(b) 1.67×10^{21}
(c) 2.67×10^{21}
(d) 1.67×10^{20}

18×20 drops $\equiv 1$ mole $= N_A$ molecule

$1\,drop = \frac{6 \times 10^{23}}{18 \times 20} = \frac{10}{6} \times 10^{21}$
$= 1.67 \times 10^{21}$

How many moles of magnesium phosphate, $Mg_3(PO_4)_2$ will contain 0.25 mole of oxygen atoms?

(a) 0.02 (b) 3.125×10^{-2} (c) 1.25×10^{-2} (d) 2.5×10^{-2}

b

$Mg_3(PO_4)_2 = x$ mole

$O = 8x$ mole $= 0.25 \Rightarrow x = 0.03125$

$= 3.125 \times 10^{-2}$

A gaseous mixture contains SO_3 (g) and C_2H_6 (g) in a 16 : 15 ratio by mass. The ratio of total number of atoms present in C_2H_6 (g) and SO_3 (g) is:

(a) 2 : 5 (b) 1 : 5 (c) 5 : 1 (d) 5 : 2

c

$\frac{SO_3}{C_2H_6} = \frac{16/80}{15/30} = \left(\frac{2}{5}\right)$ $\frac{4\times2}{8\times5} = \frac{1}{5}$ Atoms

The shape of I Tobacco Mosaic Virus (TMC) is cylindrical, having length and diameter 3000 Å and 170 Å, respectively. The density of the virus is 0.08 gm/ml. The molecular weight of TMC is:

(a) 3.28 (b) 5.44×10^{-24} (c) 5.44×10^{-18} (d) 3.28×10^{6}

d

$(\pi r^2 h)\, d = \pi \times (85 \times 10^{-8})^2 \times (3000 \times 10^{-8}) \times 0.08 \times 6 \times 10^{23}$

$= 3.28 \times 10^{6}$ amu

Avg Molar mass:-

A gaseous mixture contains 70% N_2 and 30% unknown gas, by volume. If the average molecular mass of gaseous mixture is 37.60, the molecular mass of unknown gas is

(a) 42.2
(b) 60
(c) 40
(d) 50

$n_T = 100$

$37.6 = \frac{70 \times 28 + 30 \times M}{100}$

$M = 60$

A sample of ozone gas is found to be 40% dissociated into oxygen. The average molecular mass of sample should be

$O_3(g) \longrightarrow \frac{3}{2} O_2(g)$

n_0

$n_0(1-0.4)$ $\quad \frac{3}{2} \times n_0 \times 0.4$

$n_0 \times 48 = n_0(1-0.4+0.6) \times M$

$M = \left(\frac{48}{1.2}\right) = 40$

Percentage composition:-

A quantity of 5 g of a crystalline salt when rendered anhydrous lost 1.8 g of water. The formula mass of the anhydrous salt is 160. The number of molecules of water of crystallization in the salt is

(a) 3
(b) 5
(c) 2
(d) 1

$\Rightarrow X.\, n H_2O$

$\frac{X}{H_2O} = \frac{(5-1.8)}{1.8\,gm}$

$\Rightarrow$ mole ratio

$\frac{X}{H_2O} = \left(\frac{1}{n}\right) = \frac{(3.2/160)}{(1.8/18)} = \frac{1}{5}$

$n = 5$

The percentage of oxygen in a compound is 4%. Its minimum molecular mass will be

(a) 100 (b) 400

(c) 200 (d) 32

4 gm O ⟶ 100 gm compd

16 gm O ⟶ $\frac{100}{4} \times 16$

$= 400$ gm

Rxn Stoichiometry

When 20 g Fe_2O_3 is reacted with 50 g of HCl, $FeCl_3$ and H_2O are formed. The amount of unreacted HCl is (Fe = 56)

(a) 27.375 g (b) 22.625 g

(c) 30 g (d) 4.75 g

160 36.5

$Fe_2O_3 + 6HCl \rightarrow 2FeCl_3 + 3H_2O$

0.125 1.369

mole $(1.369 - 6 \times 0.125)$

$= 0.619$ mole

$\equiv 22.625$ gm

What mass of solid ammonium carbonate $H_2NCOONH_4$, when vaporized at 273°C, will have a volume of 8.96 l at 760 mm of pressure. Assume that the solid completely decomposes as

$H_2NCOONH_4(s) \rightarrow CO_2(g) + 2NH_3(g)$

x mole x 2x

(a) 15.6 g (b) 5.2 g

(c) 46.8 g (d) 7.8 g

$3x = \frac{1 \text{ atm} \times 8.96 \text{ lit}}{0.0821 \times 2 \times 273}$

$= \left(\frac{8.96}{22.4 \times 2}\right)$

$x = \left(\frac{0.2}{3}\right)$ mole

$NH_2COONH_4 = \frac{0.2}{3} \times 78$ (26)

$= 5.2$ gm

Limiting reactants:-

Large quantities of ammonia are burned in the presence of a platinum catalyst to give nitric oxide, as the first step in the preparation of nitric acid.

$NH_3(g) + O_2(g) \xrightarrow{Pt} NO(g) + H_2O(g)$ (Unbalanced)

Suppose a vessel contains 0.12 moles NH_3 and 0.14 moles O_2. How many moles of NO may be obtained?

(a) 0.120 (b) 0.112
(c) 0.140 (d) 0.070

Equal masses of iron and sulphur are heated together to form FeS. What fraction of the original mass of excess reactant is left unreacted? (Fe = 56, S = 32)

(a) 0.22 (b) 0.43
(c) 0.86 (d) 0.57

In the reaction: $4A + 2B + 3C \rightarrow A_4B_2C_3$.
What will be the number of moles of product formed? Starting gum 2 moles of A, 1.2 moles of B and 1.44 moles of

(a) 0.5 (b) 0.6 (c) 0.48 (d) 4.64

Percentage and percentage yield based

How many grams of 90% pure Na_2SO_4 can be produced from 250 g of 95% pure NaCl?

(a) 640.6 g (b) 288.2 g
(c) 259.4 g (d) 320.3 g

Hydrazine N_2H_4 (used as a fuel in rocket system) can be produced according to the following reaction:

$$ClNH_2 + 2NH_3 \rightarrow N_2H_4 + NH_4Cl$$

When 1.0 kg $ClNH_2$ is reacted with excess of NH_3, 473 g of N_2H_4 is produced. What is the percentage yield?

(a) 76.12 (b) 67.21
(c) 26.17 (d) 16.72

A quantity of 10 g of a piece of marble was put into excess of dilute HCl acid. When the reaction was complete, 1120 cm^3 of CO_2 was obtained at 0°C and 1 atm. The percentage of $CaCO_3$ in the marble is

(a) 5%
(b) 25%
(c) 50%
(d) 2.5%

Fe_2O_3 reacts with excess CO at a high temperature according to the equation below.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

If 6.50 g of Fe_2O_3 yields 3.85 g of Fe, what is the percentage yield of the reaction?

(a) 59.2% (b) 69.9% (c) 76.3% (d) 84.7%

Sequential and parallel rxn

An amount of 2 moles $KClO_3$ is decomposed completely to produce O_2 gas. How many moles of butane, C_4H_8 can be burnt completely by the O_2 gas produced?

(a) 0.5
(b) 1.0
(c) 2.0
(d) 3.0

When 12 g graphite is burnt in sufficient oxygen, CO as well as CO_2 is formed. If the product contains 40% CO and 60% CO_2 by mass and none of the reactant is left, what is the mass of oxygen gas used in combustion?

(a) 24.0 g
(b) 21.33 g
(c) 23.8 g
(d) 15.6 g

Two successive reactions, A $\rightarrow$ B and B $\rightarrow$ C, have yields of 90% and 80%, respectively. What is the overall percentage yield for conversion of A to C?

(a) 90%
(b) 80%
(c) 72%
(d) 85%

Empirical and molecular formula

An organic compound contains 40% carbon and 6.67% hydrogen by mass. Which of the following represents the empirical formula of the compound?

(a) CH_2
(b) CH_2O
(c) C_2H_4O
(d) CH_3O

A quantity of 1.4 g of a hydrocarbon gives 1.8 g water on complete combustion. The empirical formula of hydrocarbon is

(a) CH
(b) CH_2
(c) CH_3
(d) CH_4

When a hydrocarbon is burnt completely, the ratio of masses of CO_2 and H_2O formed is 44:27. The hydrocarbon is

(a) CH_4
(b) C_2H_6
(c) C_2H_4
(d) C_2H_2

Mix

A sample of iron oxide has FeO and Fe_2O_3 in the mole ratio 2:1. It is partially oxidized to change this ratio to 1:2. The number of moles of FeO oxidized per mole of initial mixture is

[redacted]
0.2
0.333
0.4
0.5

A sample containing only $CaCO_3$ and $MgCO_3$ is ignited to CaO and MgO. The mixture of oxides produced weight exactly half as much as the original sample. Calculate the percentages of $CaCO_3$ and $MgCO_3$ (by mass) in the sample.

When 4 gm of a mixture of $NaHCO_3$ and NaCl is heated, 0.66 gm CO_2 gas is evolved. If ratio of the percentage composition (by mass) of the $NaHCO_3$ and NaCl is y : 1 then value of y is.