

① Mole  $\Rightarrow$  Na Unit

② Molar mass  $\Rightarrow$  mass of Na unit in gms

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 =  $\frac{\text{Total mass}}{\text{Total mole}} = \frac{n_1 M_1 + n_2 M_2}{n_1 + n_2}$

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

$\rightarrow$  Relative  $\Rightarrow d_{\text{rel}} = \left(\frac{d_1}{d_2}\right)$

① V.D. =  $\frac{d_{\text{Gas}}}{d_{H_2O}}$  Under same P, T

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

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

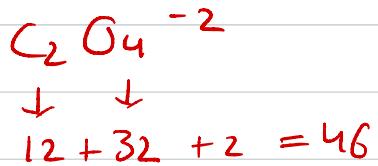
Sp gravity =  $d_{\text{Substance}} (\text{gm/cm}^3)$

## 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)  $2.1N_A$

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



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)  $2.8N_A$

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

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

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

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

$$1 \text{ amu} = \frac{1}{N_A} \text{ gm}$$

$$= \frac{1}{12} \text{ gm} \text{ mass of } C-12$$

$$= \frac{1}{12} \text{ gm} \text{ mass of } C-12$$

$$7 \times 12 + 2 \times 16 + \frac{9.96 \times 10^{-24}}{6 \times 10^{23}}$$

$$= 84 + 32 + 5.976$$

$$\approx 122$$

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)  $1.07 \times 10^{21}$
- (b)  $1.67 \times 10^{21}$
- (c)  $2.67 \times 10^{21}$
- (d)  $1.67 \times 10^{20}$

$$18 \times 20 \text{ drops} \equiv 1 \text{ mole} = N_A \text{ molecule}$$

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

$$= 1.67 \times 10^{21}$$

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

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

b



$$O = 8x \text{ mole} = 0.25 \Rightarrow x = 0.03125 \\ = \underline{\underline{3.125 \times 10^{-2}}}$$

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

$$\frac{SO_3}{C_2H_6} = \frac{16/80S}{15/30Z} = \left(\frac{2}{5}\right) \quad \frac{4 \times Z}{8 \times S} = \frac{1}{5} \text{ Atoms}$$

The shape of I Tobacco Mosaic Virus (TMC) is cylindrical, having length and diameter  $3000 \text{ } \overset{\circ}{\text{A}}$  and  $170 \text{ } \overset{\circ}{\text{A}}$ , respectively. The density of the virus is  $0.08 \text{ gm/ml}$ . The molecular weight of TMC is:

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

d

$$(\pi r^2 h) d = \pi \times (85 \times 10^{-8})^2 \times (3000 \times 10^{-8}) \times 0.08 \\ = \underline{\underline{3.28 \times 10^6 \text{ amu}}}$$

## Avg Molar mass:-

A gaseous mixture contains 70% N<sub>2</sub> and 30% unknown gas, by volume. If the average molecular mass of gaseous mixture is 37.60, the molecular mass of unknown gas is

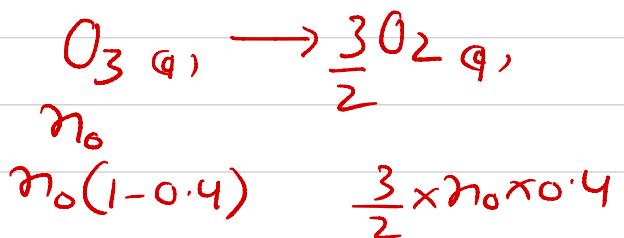
- (a) 42.2
- (b) 60
- (c) 40
- (d) 50

$$m_T = 100$$

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

$$M = 60$$

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



$$\begin{aligned} \cancel{n_o \times 48} &= \cancel{n_o}(1-0.4+0.6) \times M \\ M &= \left( \frac{48}{1.2} \right) = 40 \end{aligned}$$

## 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

$$\Rightarrow X \cdot n H_2O$$

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

$\Rightarrow$  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

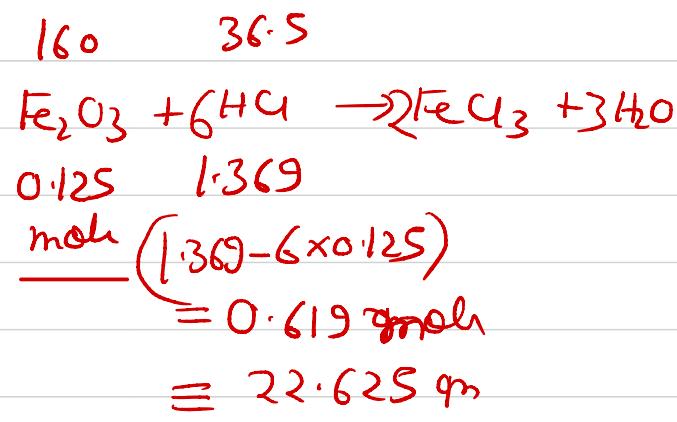
- (a) 100      ✓(b) 400  
(c) 200      (d) 32

$$\begin{array}{l} 4 \text{ gm O} \longrightarrow \frac{100 \text{ gm}}{\text{Compel}} \\ 16 \text{ gm O} \longrightarrow \frac{100}{4} \times 16 \\ = \underline{400 \text{ gm}} \end{array}$$

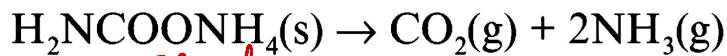
## Rxn Stoichiometry

When 20 g  $\text{Fe}_2\text{O}_3$  is reacted with 50 g of HCl,  $\text{FeCl}_3$  and  $\text{H}_2\text{O}$  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



What mass of solid ammonium carbonate  $\text{H}_2\text{NCOONH}_4$ , when vaporized at  $273^\circ\text{C}$ , will have a volume of 8.96 l at 760 mm of pressure. Assume that the solid completely decomposes as

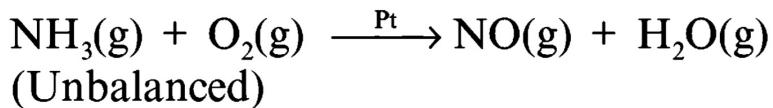


- (a) 15.6 g      ✓(b) 5.2 g  
(c) 46.8 g      (d) 7.8 g

$$\begin{array}{l} 3x = \frac{1 \text{ atm} \times 8.96 \text{ lit}}{0.0821 \times 2 \times 273} \\ = \left( \frac{8.96}{22.4 \times 2} \right) \\ x = \left( \frac{0.2}{3} \right) \text{ mol} \\ \text{Molar mass of } \text{H}_2\text{NCOONH}_4 = \frac{0.2}{3} \times 78 \\ = 5.2 \text{ gm} \end{array}$$

## **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.



Suppose a vessel contains 0.12 moles  $\text{NH}_3$ , and 0.14 moles  $\text{O}_2$ . How many moles of  $\text{NO}$  may be obtained?



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)



In the reaction:  $4A + 2B + 3C \rightarrow A_4B_2C_3$ .

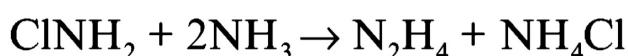
What will be the number of moles of product formed? Starting gum 2 moles of A, 1.2 moles of B and 1.44 moles of

## Percentage and percentage yield based

How many grams of 90% pure  $\text{Na}_2\text{SO}_4$  can be produced from 250 g of 95% pure  $\text{NaCl}$ ?

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

Hydrazine  $\text{N}_2\text{H}_4$  (used as a fuel in rocket system) can be produced according to the following reaction:



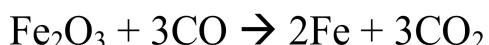
When 1.0 kg  $\text{ClNH}_2$  is reacted with excess of  $\text{NH}_3$ , 473 g of  $\text{N}_2\text{H}_4$  is produced. What is the percentage yield?

- (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,  $1120 \text{ cm}^3$  of  $\text{CO}_2$  was obtained at  $0^\circ\text{C}$  and 1 atm. The percentage of  $\text{CaCO}_3$  in the marble is

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

$\text{Fe}_2\text{O}_3$  reacts with excess CO at a high temperature according to the equation below.



If 6.50 g of  $\text{Fe}_2\text{O}_3$  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  $\text{KClO}_3$  is decomposed completely to produce  $\text{O}_2$  gas. How many moles of butane,  $\text{C}_4\text{H}_8$  can be burnt completely by the  $\text{O}_2$  gas produced?

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

When 12 g graphite is burnt in sufficient oxygen,  $\text{CO}$  as well as  $\text{CO}_2$  is formed. If the product contains 40%  $\text{CO}$  and 60%  $\text{CO}_2$  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,  $\text{A} \rightarrow \text{B}$  and  $\text{B} \rightarrow \text{C}$ , 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)  $\text{CH}_2$
- (b)  $\text{CH}_2\text{O}$
- (c)  $\text{C}_2\text{H}_4\text{O}$
- (d)  $\text{CH}_3\text{O}$

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)  $\text{CH}_2$
- (c)  $\text{CH}_3$
- (d)  $\text{CH}_4$

When a hydrocarbon is burnt completely, the ratio of masses of  $\text{CO}_2$  and  $\text{H}_2\text{O}$  formed is 44:27. The hydrocarbon is

- |                            |                            |
|----------------------------|----------------------------|
| (a) $\text{CH}_4$          | (b) $\text{C}_2\text{H}_6$ |
| (c) $\text{C}_2\text{H}_4$ | (d) $\text{C}_2\text{H}_2$ |

## Mix

A sample of iron oxide has  $\text{FeO}$  and  $\text{Fe}_2\text{O}_3$  in the mole ratio 2:1. It is partially oxidized to change this ratio to 1:2. The number of moles of  $\text{FeO}$  oxidized per mole of initial mixture is

- 0.2
- 0.333
- 0.4
- 0.5

A sample containing only  $\text{CaCO}_3$  and  $\text{MgCO}_3$  is ignited to  $\text{CaO}$  and  $\text{MgO}$ . The mixture of oxides produced weight exactly half as much as the original sample. Calculate the percentages of  $\text{CaCO}_3$  and  $\text{MgCO}_3$  (by mass) in the sample.

When 4 gm of a mixture of  $\text{NaHCO}_3$  and  $\text{NaCl}$  is heated, 0.66 gm  $\text{CO}_2$  gas is evolved. If ratio of the percentage composition (by mass) of the  $\text{NaHCO}_3$  and  $\text{NaCl}$  is  $y : 1$  then value of  $y$  is.