Eudiometry

Gay-Lussac's law of volume combination holds good. According to this law, the volumes of gaseous reactants reacted and the volumes of gaseous products formed, all measured at the same temperature and pressure, bear a simple ratio.

$$N_2\,(g) + 3H_2\,(g) \longrightarrow 2NH_3\,(g)$$
1 vol. 3 vol. 2 vol.

Problem may be solved directly is terms of volume, in place of mole. The stoichiometric coefficients of a balanced chemical reactions gives the ratio of volumes in which gaseous substances are reacting and products are formed, at same temperature and pressure.

Eg: $CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(l)}$ (excess)

The total volume of non-reacting gaseous mixture is equal to sum of partial volumes of the component gases **(Amagat's law)**.

$V = V_1 + V_2 + \ldots\ldots\ldots\ldots$

Partial volume of gas in a non-reacting gasesous mixture is its volume when the entire pressure of the mixture is supposed to be exerted only by that gas.

Volume contraction

$H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(g)}$

200 200 200 ml

100

300 − 400 = −100

$C_xH_{y(g)} + \left(x + \frac{y}{4}\right)O_{2(g)} \longrightarrow xCO_{2(g)} + \frac{y}{2}H_2O_{(l)}$

$C_xH_yO_{z(g)} + \left(x + \frac{y}{4} - \frac{z}{2}\right)O_{2(g)} \longrightarrow xCO_{2(g)} + \frac{y}{2}H_2O_{(l)}$

$C_{x_1}H_{x_2}O_{x_3}N_{x_4}Cl_{x_5}S_{x_6} + O_{2(g)} \longrightarrow CO_{2(g)} + H_2O_{(l)} + N_{2(g)} + Cl_{2(g)} + SO_{2(g)}$

The volume of gases produced is often given by certain solvent which absorb contain gases.

Solvent	**Gases absorb**
KOH	CO_2, SO_2, Cl_2
Ammonical Cu_2Cl_2	CO
Turpentine oil	O_3
Alkaline pyrogallol	O_2
water	NH_3, HCl
$CuSO_4/CaCl_2$	H_2O

15 ml of gaseous butane is burnt with 105 ml of oxygen gas at room temperature and pressure. Contraction in volume observed will be:

(a) expansion in volume will be observed

(b) 60 ml (c) 52.5 ml (d) 65 ml

c

$C_4H_{10}(g) + \frac{13}{2}O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)$

15 ml 105 ml

$(105 - 97.5) = 7.5$ ml 60 ml

$\Delta V = (60 + 7.5) - (15 + 105) = -52.5$ ml

500 ml of a hydrocarbon gas burnt in excess of oxygen yields 2500 ml of CO_2 and 3 litres of water vapour. All volume being measured at the same temperature and pressure. The formula of the hydrocarbon is:

(a) C_5H_{10} (b) C_5H_{12} (c) C_4H_{10} (d) C_4H_8

b

$C_xH_y(g) + \left(x + \frac{y}{4}\right)O_2(g) \longrightarrow xCO_2(g) + \frac{y}{2}H_2O(g)$

500 ml excess

$500x = 2500$ $500 \times \frac{y}{2} = 3000$

$x = 5$ $y = 12$

7.5 ml of a gaseous hydrocarbon was exploded with 36 ml of oxygen. The volume of gases on cooling was found to be 28.5 ml, 15 ml of which was absorbed by KOH and the rest was absorbed in a solution of alkaline pyrogallol. If all volumes are measured under same conditions, the formula of hydrocarbon is:

(a) C_3H_4 (b) C_2H_4 (c) C_2H_6 (d) C_3H_6

: b

$C_xH_y(g) + \left(x + \frac{y}{4}\right)O_2(g) \longrightarrow xCO_2(g) + \frac{y}{2}H_2O(l)$

7.5 ml 36 ml

$36 - \left(x + \frac{y}{4}\right)7.5$ $7.5x$

$36 - \left(x + \frac{y}{4}\right)7.5 + 7.5x = 28.5$ — (i) $\Rightarrow 36 - 7.5 \times \frac{y}{4} = 28.5$

$y = 4$

$7.5x = 15$ — (ii) $x = 2$

20 ml of a mixture of CO_2 and C_2H_4 was mixed with excess of O_2 gas and was exploded. On bringing the solution back to the original room temperature a contraction of 12 ml was observed. What is the volume percentage of CO_2 in the original mixture?

(a) 6% (b) 14% ✓(c) 70% (d) 30%

c

$C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(g)$

x — excess = V ml — $(20-x)$ —

— $V-3x$ — $(20-x)+2x$ —

$\Delta V = [V-3x+20+x] - [20+V] = -12$

$-2x = -12 \Rightarrow x = 6$

$\%CO_2 = \frac{14}{20} \times 100 = 70\%$

1 volume of gaseous compound consisting C, H, O on complete combustion in presence of 2.5 volume of O_2 gives 2 vol. of steam and 2 vol. of CO_2, what is the formula of the compound if all measurements are made at NTP?

✓(a) C_2H_4O (b) CH_3O (c) C_2H_2O (d) $C_2H_3O_2$

a

$C_xH_yO_z + \left(x+\frac{y}{4}-\frac{z}{2}\right)O_2(g) \rightarrow xCO_2(g) + \frac{y}{2}H_2O(g)$

$1V$ — $2.5V$ — $2V$ — $2V$

$= xV$ — $= \frac{y}{2}V$

$x=2$ — $y=4$

1120 ml of ozonised oxygen ($O_2 + O_3$) at 1 atm and 273 K weighs 1.76 gm. The reduction in volume on passing the mixture through alkaline pyrogallol solution is:

✓(a) 896 ml (b) 224 ml (c) 448 ml (d) 672 ml

a

$1 \times 1.120 = \frac{1.76}{M_{mix}} \times (0.0821 \times 273) = \frac{1.76}{M} \times 22.4$ 20

$M_{mix} = 35.2 = \frac{x \times 32 + (1120-x)48}{1120}$

$x = 896$ ml

Percentage of elements determination:-

S=32, Ag=108, Br=80

0.15 gm of an organic compound gave 0.12 gm of silver bromide by the Carius method. Find the percentage of bromine in the compound.

(a) 34.0 (b) 40 (c) 17 (d) 68

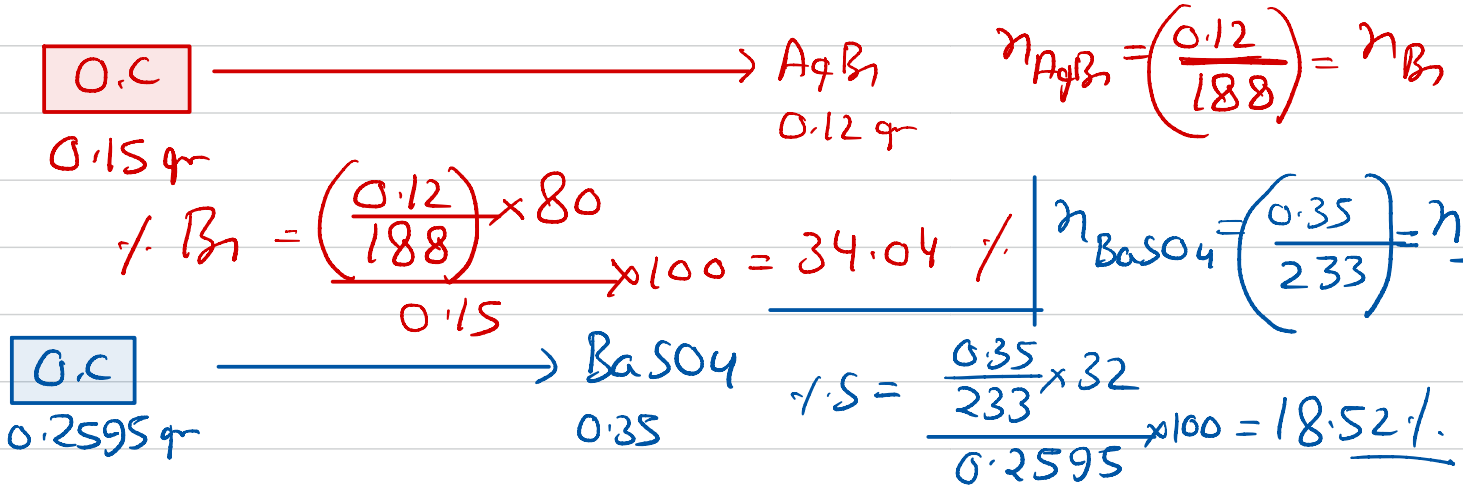
a

Ba=137

0.2595 gm of an organic substance when treated by Carius method gave 0.35gm of $BaSO_4$. Calculate the percentage of sulphur in the compound.

(a) 9 (b) 30.4 (c) 18.52 (d) 40.52

c



0.12 gm of an organic compound containing phosphorus gave 0.22 gm of $Mg_2P_2O_7$ by the usual analysis. Calculate the percentage of phosphorus in the compound.

(a) 25 (b) 9.25 (c) 801 (d) 51.20

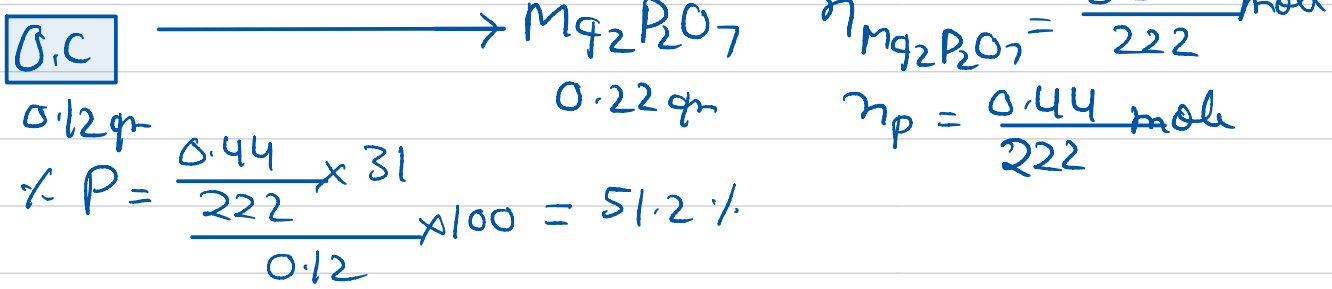
P=31
Mg=24

d

An organic compound has 6.2% of phosphorus. In the reaction sequence, all phosphorous present in the 10 gm of organic compound is converted to $Mg_2P_2O_7$. Find wt. of $Mg_2P_2O_7$ formed.

(a) 2.22 (b) 10.2 (c) 15 (d) 20

a



O.C = 10 gm $\Rightarrow$ P = 0.62 gm $\Rightarrow$ 0.02 mole $\Rightarrow$ $n_{Mg_2P_2O_7} = 0.01$ mole

$m_{Mg_2P_2O_7} = 0.01 \times 222 = 2.22$ gm

VKT sir

0.30 gm of an–organic compound gave 50 ml of nitrogen collected at 300K and 715 mm pressure in water or Duma's method. Calculate the percentage of nitrogen in the compound. (Vapour pressure of aqueous tension of water at 300 K is 15 mm)

(a) 10.2 (b) 17.46 (c) 24 (d) 34

0.50 gm of an organic compound was treated according to Kjeldahl's method. The ammonia evolved was absorbed in 50 ml of 0.5 M H_2SO_4. The residual acid required 60 ml of $\frac{M}{2}$ NaOH solution. Find the percentage of nitrogen in the compound.

(a) 50 (b) 56 (c) 66 (d) 40

0.4 gm of an organic compound was treated according to Kjeldahl's method. The ammonia evolved was absorbed in 50 ml of 0.5 M H_3PO_3. The residual acid required 30 ml of 0.5M $Ca(OH)_2$. Find the percentage of N_2 in the compound.

(a) 20 (b) 50 (c) 70 (d) 90

0.002 gm of an organic compound was treated according to Kjeldahl's method. 0.2×10^{-4} mol of H_2SO_4 was required to neutralise NH_3. Calculate the percentage of N.

(a) 50 (b) 28 (c) 70 (d) 18