MOLE CONCEPT

1. Amongst the following statements, that which was not proposed by Dalton was :

(1) all the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass.

(2) chemical reactions involve reorganisation of atoms. These are neither created nor destroyed in a chemical reaction.

(3) when gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume provided all gases are at the same T & P.

(4) matter consists of indivisible atoms.

2. The ammonia (NH_3) released on quantitative reaction of 0.6 g urea (NH_2CONH_2) with sodium hydroxide (NaOH) can be neutralized by :

(1) 100 ml of 0.1 N HCl

(2) 200 ml of 0.4 N HCl

(3) 100 ml of 0.2 N HCl

(4) 200 ml of 0.2 N HCl

3. Ferrous sulphate heptahydrate is used to fortify foods with iron. The amount (in grams) of the salt required to achieve 10 ppm of iron in 100 kg of wheat is _____.

Atomic weight : Fe = 55.85 ; S = 32.0 ; O = 16.00

4. $NaClO_3$ is used, even in spacecrafts, to produce O_2. The daily consumption of pure O_2 by a person is 492L at 1 atm, 300K. How much amount of $NaClO_3$, in grams, is required to produce O_2 for the daily consumption of a person at 1 atm, 300 K ?

$NaClO_3(s) + Fe(s) \rightarrow O_2(g) + NaCl(s) + FeO(s)$

$R = 0.082$ L atm mol^{-1} K^{-1}

5. The first and second ionisation enthalpies of a metal are 496 and 4560 kJ mol^{-1}, respectively. How many moles of HCl and H_2SO_4, respectively, will be needed to react completely with 1 mole of the metal hydroxide ?

(1) 1 and 0.5 (2) 2 and 0.5

(3) 1 and 1 (4) 1 and 2

6. 5 g of zinc is treated separately with an excess of

(a) dilute hydrochloric acid and

(b) aqueous sodium hydroxide.

The ratio of the volumes of H_2 evolved in these two reactions is :

(1) 1 : 4 (2) 1 : 2 (3) 2 : 1 (4) 1 : 1

7. The minimum number of moles of O_2 required for complete combustion of 1 mole of propane and 2 moles of butane is _____.

8. The ratio of the mass percentages of 'C & H' and 'C & O' of a saturated acyclic organic compound 'X' are 4 : 1 and 3 : 4 respectively. Then, the moles of oxygen gas required for complete combustion of two moles of organic compound 'X' is _____ .

9. In an estimation of bromine by Carius method, 1.6 g of an organic compound gave 1.88 g of AgBr. The mass percentage of bromine in the compound is _____

(Atomic mass, Ag=108, Br = 80 g mol^{-1})

SOLUTION

1. NTA Ans. (3)

Sol. Option(3) is according to Gaylussac's law of volume combination.

2. NTA Ans. (3)

Sol. $NH_2CONH_2 + 2NaOH \rightarrow Na_2CO_3 + 2NH_3$

10 mmoles 20mmoles

Hence, NH_3 will require 20 meq.

3. NTA Ans. (4.95 to 4.97)

Sol. $FeSO_4.7H_2O$ (M = 277.85)

$$ppm = \frac{wt.of\ Fe}{wt.of\ wheat}\times 10^6$$

let the wt. of salt be = w gm

$$moles = \frac{w}{277.85}$$

$$wt.\ of\ Fe = \left(\frac{W}{277.85}\times 55.85\right)gm$$

$$10 = \frac{\frac{W}{277.85}\times 55.85}{10^5}\times 10^6$$

$$W = \frac{277.85}{55.85} = 4.97$$

4. NTA Ans. (2120 to 2140)

Sol. Mole of O_2 consumed $= \frac{1\times 492}{0.082\times 300} = 20$

Mole of $NaClO_3$ required = 20

Mass of $NaClO_3$ = 20 × 106.5 = 2130 gm

5. NTA Ans. (1)

Sol. IE values indicate, that the metal belongs to Ist group since second IE is very high ($\because$ only one valence electron)

Metal hydroxide will be of type, MOH.

$MOH + HCl \rightarrow MCl + H_2O$

(1mol) (1mol)

$$MOH + \frac{1}{2}H_2SO_4 \rightarrow \frac{1}{2}M_2SO_4 + H_2O$$

(1mol) ($\frac{1}{2}$ mol)

So one mole of HCl required to react with one mole MOH.

So $\frac{1}{2}$ mole of H_2SO_4 required to react with one mole MOH.

6. NTA Ans. (4)

Sol. $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

$Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$

The ratio of the volume of H_2 is 1 : 1

7. Official Ans. by NTA (18)

Sol. $\underset{1mole}{C_3H_8} + \underset{5mole}{5O_2} \rightarrow 3CO_2 + 4H_2O$

For 1 mole propane combustion 5 mole O_2 required

$$C_4H_{10} + \frac{13}{2}O_2 \rightarrow 4CO_2 + 5H_2O$$

1 mole 6.5 mole

2 mole 13 mole

For 2 moles of butane 13 mole of O_2 is required

total moles = 13 + 5 = 18

8. Official Ans. by NTA (5.00)

Sol. C : H = 4 : 1

C : O = 3 : 4

Mass ratio

C : H : O = 12 : 3 : 16

Mole ratio

C : H : O = 1 : 3 : 1

Empirical formula = CH_3O

Molecular formula = $C_2H_6O_2$

(saturated acyclic organic compound)

$$C_2H_6O_2 + \frac{5}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$$

2 mole 5 mol

Moles of O_2 required = 5 moles

9. Official Ans. by NTA (50.00)