2. Mole concept

Let us Assess

1. Question

Suppose 20 molecules of hydrogen are allowed to react with 20 molecules of oxygen to produce water.

a. Which of the reactant molecules gets consumed first?

b. The molecules of which reactant will remain unreacted? How many?

Answer

a. $20\ H_2 + 20\ O \rightarrow 20H_2O$

The reactant molecules of oxygen get consumed first. Because there is only atom of oxygen present.

b. If equal number of molecules of hydrogen and oxygen is taken, the reaction gets completed with none of the reactants remaining unreacted.

2. Question

Which, among the following, is used as the basis for expressing atomic mass?

(Hydrogen, Carbon - 12, Carbon - 14, Oxygen - 16)

Answer

Carbon

The atomic mass of elements is expressed by considering 1/12 the mass of an atom of carbon-12 isotope as one unit. This mass is called unified mass (u)

$$1\ \text{u} = \frac{1}{12} \times \text{mass of carbon} - 12\ \text{atom}$$

3. Question

The atomic mass of helium is 4 and that of oxygen is 16. How many grams of helium is required to get as many number of atoms as are present in 40 g of oxygen.

(40 g, 160 g, 10 g, 4 g)

Answer

Given:

Atomic mass of helium = 4

Atomic mass of oxygen = 16

Mass of oxygen = 40 g

Hence, we can write

$$\frac{\text{Mass of helium}}{\text{Atomic mass of helium}} = \frac{\text{Mass of oxygen}}{\text{Atomic mass of oxygen}}$$

By putting the values, we get:

$$\frac{\text{Mass of helium}}{4} = \frac{40\text{g}}{16}$$

By applying criss cross method:

$$\frac{\text{Mass of helium}\ \ 40\text{g}}{4 \qquad\quad 16}$$

We get:

Mass of helium × 16 = 4 × 40g

$$\text{Mass of helium} = \frac{4 \times 40g}{16}$$

Mass of helium = 10g

Thus, 10 grams of helium is required.

4 A. Question

Find the number of gram atomic masses in each of the following.

100 g of helium

(Atomic mass He = 4, O = 16, N = 14, Ca = 40)

Answer

Gram atomic mass: The mass of an element in grams is numerically equal to the atomic mass of the element is one gram atomic mass.

1 GAM (gram atomic mass) = Mass in grams equal to atomic mass

a. Given: Mass of helium = 100g

Atomic mass of helium = 4

1 GAM of helium = 4g

Apply the formula given below:

$$\text{Number of gram atomic mass} = \frac{\text{mass of element}}{\text{GAM of the element}}$$

$$\text{Number of gram atomic mass} = \frac{\text{mass of helium}}{\text{GAM of the helium}}$$

$$\text{Number of gram atomic mass} = \frac{100g}{4g}$$

Number of gram atomic mass = 25g

Thus, number of gram atomic mass of helium is 25g

4 B. Question

Find the number of gram atomic masses in each of the following.

200 g of oxygen

(Atomic mass He = 4, O = 16, N = 14, Ca = 40)

Answer

Given: Mass of oxygen = 200g

Atomic mass of oxygen = 16

1 GAM of oxygen = 16g

Apply the formula given below:

$$\text{Number of gram atomic mass} = \frac{\text{mass of element}}{\text{GAM of the element}}$$

$$\text{Number of gram atomic mass} = \frac{\text{mass of oxygen}}{\text{GAM of the oxygen}}$$

$$\text{Number of gram atomic mass} = \frac{200g}{16g}$$

Number of gram atomic mass = 12.5

Thus, number of gram atomic mass of oxygen is 12.5.

4 C. Question

Find the number of gram atomic masses in each of the following.

70 g of nitrogen

(Atomic mass He = 4, O = 16, N = 14, Ca = 40)

Answer

Given: Mass of nitrogen = 70g

Atomic mass of nitrogen = 14

1 GAM of nitrogen = 14g

Apply the formula given below:

$$\text{Number of gram atomic mass} = \frac{\text{mass of element}}{\text{GAM of the element}}$$

$$\text{Number of gram atomic mass} = \frac{\text{mass of nitrogen}}{\text{GAM of the nitrogen}}$$

$$\text{Number of gram atomic mass} = \frac{70\text{g}}{14\text{g}}$$

Number of gram atomic mass = 5

Thus, number of gram atomic mass of nitrogen is 5

4 D. Question

Find the number of gram atomic masses in each of the following.

1 g of calcium

(Atomic mass He = 4, O = 16, N = 14, Ca = 40)

Answer

Given: Mass of calcium = 1g

Atomic mass of calcium = 40

1 GAM of calcium = 40g

Apply the formula given below:

$$\text{Number of gram atomic mass} = \frac{\text{mass of element}}{\text{GAM of the element}}$$

$$\text{Number of gram atomic mass} = \frac{\text{mass of calcium}}{\text{GAM of the calcium}}$$

$$\text{Number of gram atomic mass} = \frac{1\text{g}}{40\text{g}}$$

Number of gram atomic mass = 0.025g

Thus, number of gram atomic mass of calcium is 0.025

5 A. Question

Calculate the gram molecular mass/gram formula mass of the following.

HNO_3

(Gram atomic masses H = 1 g, N = 14 g, O = 16 g, Na = 23 g, S = 32 g, Cl = 35.5 g, Ca = 40 g)

Answer

Gram molecular mass (GMM): The mass in grams equal to the molecular mass of an element or compound is called its gram molecular mass.

1 GMM = Mass in grams equal to atomic mass

HNO_3

Gram atomic mass of H=1g

Gram atomic mass of N=14g

Gram atomic mass of O=16g

GMM of HNO_3 = 1g + 14g + 3× 16g

GMM of HNO_3 = 63g

Thus, gram molecular mass of HNO_3 is 63g

5 B. Question

Calculate the gram molecular mass/gram formula mass of the following.

$CaCl_2$

(Gram atomic masses H = 1 g, N = 14 g, O = 16 g, Na = 23 g, S = 32 g, Cl = 35.5 g, Ca = 40 g)

Answer

$CaCl_2$

Gram atomic mass of Ca=40g

Gram atomic mass of Cl=35.5g

GMM of $CaCl_2$ = 40g + 2 × 35.5g

GMM of $CaCl_2$ = 111g

Thus, gram molecular mass of $CaCl_2$ is 111g

5 C. Question

Calculate the gram molecular mass/gram formula mass of the following.

Na_2SO_4

(Gram atomic masses H = 1 g, N = 14 g, O = 16 g, Na = 23 g, S = 32 g, Cl = 35.5 g, Ca = 40 g)

Answer

Na_2SO_4

Gram atomic mass of Na=11g

Gram atomic mass of S=32g

Gram atomic mass of O=16g

GMM of Na_2SO_4 = 2× 11g + 32g + 4× 16g

GMM of Na_2SO_4 = 22g + 32g + 64g

GMM of Na_2SO_4 = 118g

Thus, gram molecular mass of Na_2SO_4 is 118g

5 D. Question

Calculate the gram molecular mass/gram formula mass of the following.

NH_4NO_3

(Gram atomic masses H = 1 g, N = 14 g, O = 16 g, Na = 23 g, S = 32 g, Cl = 35.5 g, Ca = 40 g)

Answer

NH_4NO_3

Gram atomic mass of N=14g

Gram atomic mass of H=1g

Gram atomic mass of O=16g

GMM of NH_4NO_3 = 14g + 4×1g + 14g + 3× 16g

GMM of NH_4NO_3 = 14g + 4g + 14g + 48g

GMM of NH_4NO_3 = 80g

Thus, gram molecular mass of NH_4NO_3 is 80g

6. Question

Given below are a few samples.

a. 400 g of water (H_2O)

b. 400 g of carbon (C)

c. 400 g of helium (He)

d. 400 g of hydrogen (H_2)

e. 400 g of glucose ($C_6H_{12}O_6$)

(i) Find the number of moles in each.

(ii) Arrange the samples in the increasing order of their number of moles.

(Gram molecular masses He = 4 g, C = 12 g, H_2 = 2 g, H_2O = 18 g, $C_6H_{12}O_6$ = 180 g)

Answer

One mole: The amount of any substance containing 6.022×10^{23} particles is called one mole.

a. Given: Mass of water = 400g

Gram molecular mass (GMM) of H_2O = 18g

Apply the formula:

$$\text{Number of moles} = \frac{\text{Mass of water}}{\text{Gram molecular mass of water}}$$

$$\text{Number of moles} = \frac{400\text{g}}{18\text{g}}$$

Number of moles = 22.2

Thus, number of moles of the given sample is 22.2

b. Given: Mass of carbon = 400g

Gram molecular mass (GMM) of carbon = 12g

Apply the formula:

$$\text{Number of moles} = \frac{\text{Mass of carbon}}{\text{Gram molecular mass of carbon}}$$

$$\text{Number of moles} = \frac{400\text{g}}{12\text{g}}$$

Number of moles = 33.3

Thus, number of moles of the given sample is 33.3

c. Given: Mass of helium = 400g

Gram molecular mass (GMM) of He = 4g

Apply the formula:

$$\text{Number of moles} = \frac{\text{Mass of helium}}{\text{Gram molecular mass of helium}}$$

$$\text{Number of moles} = \frac{400\text{g}}{4\text{g}}$$

Number of moles = 100

Thus, number of moles of the given sample is 100

d. Given: Mass of hydrogen = 400g

Gram molecular mass (GMM) of H_2 = 2g

Apply the formula:

$$\text{Number of moles} = \frac{\text{Mass of hydrogen}}{\text{Gram molecular mass of hydrogen}}$$

$$\text{Number of moles} = \frac{400\text{g}}{2\text{g}}$$

Number of moles = 200

Thus, number of moles of the given sample is 200

e. Given: Mass of glucose = 400g

Gram molecular mass (GMM) of $C_6H_{12}O_6$ = 180 g

Apply the formula:

$$\text{Number of moles} = \frac{\text{Mass of glucose}}{\text{Gram molecular mass of glucose}}$$

$$\text{Number of moles} = \frac{400\text{g}}{180\text{g}}$$

Number of moles = 2.22

Thus, number of moles of the given sample is 2.22

ii) Arrangement of the samples in the increasing order of their number of moles is:

Glucose < Water <Carbon < Helium < Hydrogen

7 A. Question

Calculate the following.

Number of moles in 1 kg of water.

(GMM/GFM: H_2O - 18 g, $CaCO_3$ - 100 g, CO_2 - 44 g, NH_3 - 17 g)

Answer

Given: Mass of water = 1kg =1000g

Gram molecular mass of H_2O = 18g

To calculate the number of moles, apply the formula given:

$$\text{Number of moles} = \frac{\text{Mass of water}}{\text{Gram molecular mass of water}}$$

$$\text{Number of moles} = \frac{1000g}{18g}$$

Number of moles = 55.5

Thus, number of moles in 1 kg of water is 55.5

7 B. Question

Calculate the following.

Number of moles in 500 g of $CaCO_3$.

(GMM/GFM: H_2O - 18 g, $CaCO_3$ - 100 g, CO_2 - 44 g, NH_3 - 17 g)

Answer

Given: Mass of calcium carbonate = 500g

Gram molecular mass of $CaCO_3$ = 100g

To calculate the number of moles, apply the formula given:

$$\text{Number of moles} = \frac{\text{Mass of } CaCO_3}{\text{Gram molecular mass of } CaCO_3}$$

$$\text{Number of moles} = \frac{500g}{100g}$$

Number of moles = 5

Thus, number of moles in 500g of $CaCO_3$ is 5

7 C. Question

Calculate the following.

Number of molecules and total number of atoms in 88 g of CO_2.

(GMM/GFM: H_2O - 18 g, $CaCO_3$ - 100 g, CO_2 - 44 g, NH_3 - 17 g)

Answer

Given: Mass of CO_2 = 88g

Gram molecular mass of CO_2 = 44g

To calculate the number of molecules, first we apply the formula:

$$\text{Number of gram molecules} = \frac{\text{mass in grams}}{\text{gram molecular mass (GMM)}}$$

$$\text{Number of gram molecules} = \frac{\text{mass of } CO_2}{\text{GAM of the } CO_2}$$

$$\text{Number of gram molecules} = \frac{88g}{44g}$$

Number of gram molecules = 2

Now, number of molecules = $2 \times 6.022 \times 10^{23}$

$= 1.2 \times 10^{24}$

Thus, number of molecules of CO_2 is 1.2×10^{24}

There are three atoms in CO_2 (1atom of carbon and two atoms of oxygen)

∴ Total number of atoms = 3 × Number of molecules

$= 3 \times 1.2 \times 10^{24}$

$= 3.6 \times 10^{24}$

Thus, total number of atoms of CO_2 is 3.6×10^{24}

7 D. Question

Calculate the following.

Volume of 170 g ammonia at STP.

(GMM/GFM: H_2O - 18 g, $CaCO_3$ - 100 g, CO_2 - 44 g, NH_3 - 17 g)

Answer

Given: Mass of ammonia at STP = 170g

Molecular mass of NH_3 = 17g

First, we will calculate the number of moles by applying the formula given:

$$\text{Number of moles} = \frac{\text{Mass of } NH_3}{\text{Gram molecular mass of } NH_3}$$

$$\text{Number of moles} = \frac{170g}{17g}$$

Number of moles = 10

Thus, number of moles of $CaCO_3$ is 10

Now 1 mole of any gas occupies 22.4 litres of volume.

∴ 1 mole of NH_3 = 22.4 litre

10 moles of NH_3 = 22.4 × 10 = 224 litres

Thus, the volume occupied by 170g of NH_3 is 224 litres.

7 E. Question

Calculate the following.

The mass of 112 L CO_2 gas at STP and the number of molecules.

(GMM/GFM: H_2O - 18 g, $CaCO_3$ - 100 g, CO_2 - 44 g, NH_3 - 17 g)

Answer

Given: Volume of CO_2 gas at STP = 112L

Gram molecular mass of CO_2 = 44g

First, we will calculate the number of moles so that we can find the mass of CO_2 gas

As we know 1 mole of any gas occupies 22.4 litres of volume.

∴ 1 mole of NH_3 = 22.4 litre

22.4 × Number of moles = 112 litres

$$\text{Number of moles} = \frac{112\text{L}}{22.4\text{L}}$$

Number of moles = 5

Now, we can calculate the mass of CO_2 gas by applying the formula given:

$$\text{Number of moles} = \frac{\text{Mass of } CO_2 \text{ gas}}{\text{Gram molecular mass of } CO_2}$$

We can write,

Mass of CO_2 gas = Number of moles × GMM of CO_2

Mass of CO_2 gas = 5 × 44g

Mass of CO_2 gas = 220g

Thus, mass of 112 L CO_2 gas at STP is 220g

Now, number of molecules = Number of moles × 6.022×10^{23}

$= 5 \times 6.022 \times 10^{23}$

$= 3.011 \times 10^{24}$

Thus, number of molecules of CO_2 is 3.011×10^{24}

Extended Activities

1. Question

How many grams of carbon and oxygen are required to get the same number of atoms as is present in one gram of helium?

Answer

Atomic mass of carbon = 12

Atomic mass of oxygen = 16

Atomic mass of helium = 4

Mass of helium = 1g

For carbon:

$$\frac{\text{Mass of carbon}}{\text{Atomic mass of carbon}} = \frac{\text{Mass of helium}}{\text{Atomic mass of helium}}$$

By putting the values, we get:

$$\frac{\text{Mass of carbon}}{12} = \frac{1\text{g}}{4}$$

By applying criss cross method:

$$\frac{\text{Mass of carbon}}{12} \quad \frac{1\text{g}}{4}$$

We get:

Mass of carbon × 4 = 12 × 1g

$$\text{Mass of carbon} = \frac{12 \times 1\text{g}}{4}$$

Mass of carbon = 3g

Thus, 3 grams of carbon is required.

For oxygen:

$$\frac{\text{Mass of oxygen}}{\text{Atomic mass of oxygen}} = \frac{\text{Mass of helium}}{\text{Atomic mass of helium}}$$

By putting the values, we get:

$$\frac{\text{Mass of oxygen}}{16} = \frac{1g}{4}$$

By applying criss cross method:

$$\frac{\text{Mass of oxygen}\quad 1g}{16 \quad\quad 4}$$

We get:

Mass of oxygen × 4 = 16 × 1g

$$\text{Mass of oxygen} = \frac{16 \times 1g}{4}$$

Mass of oxygen = 4g

Thus, 4 grams of oxygen is required.

2 A. Question

Examine the samples given:

a. 20 g of He

b. 44.8 L of NH_3 at STP

c. 67.2 L of N_2 at STP

d. 1 mol of H_2SO_4

e. 180 g of water

Arrange the samples in increasing order of the number of molecules in each.

Answer

i) Calculation of number of molecules in each:

a. Given: Mass of He = 20g

Gram molecular mass of He = 4g

To calculate the number of molecules, first we apply the formula:

$$\text{Number of gram molecules} = \frac{\text{mass in grams}}{\text{gram molecular mass (GMM)}}$$

$$\text{Number of gram molecules} = \frac{\text{mass of He}}{\text{GMM of the He}}$$

$$\text{Number of gram molecules} = \frac{20g}{4g}$$

Number of gram molecules = 5

Now, number of molecules = $5 \times 6.022 \times 10^{23}$

= 3.011×10^{24}

Thus, number of molecules of He is 3.011×10^{24}

b. Given: Volume of NH_3 at STP = 44.8L

Gram molecular mass of NH_3 = 17g

First we will calculate the number of moles so that we can find the number of molecules.

As we know that 1 mole of any gas occupies 22.4 litres of volume.

∴ 1 mole of NH_3 = 22.4 litre

22.4 × Number of moles = 44.8 litres

$$\text{Number of moles} = \frac{44.8\text{L}}{22.4\text{L}}$$

Number of moles = 2

Now, number of molecules = No. of moles × 6.022×10^{23}

= $2 \times 6.022 \times 10^{23}$

= 1.204×10^{24}

Thus, number of molecules of NH_3 is 1.204×10^{24}

c. Given: Volume of N_2 at STP = 67.2L

Gram molecular mass of N_2 = 28g

First we will calculate the number of moles so that we can find the number of molecules.

As we know that 1 mole of any gas occupies 22.4 litres of volume.

∴ 1 mole of NH_3 = 22.4 litre

22.4 × Number of moles = 67.2 litres

$$\text{Number of moles} = \frac{67.2\text{L}}{22.4\text{L}}$$

Number of moles = 3

Now, number of molecules = No. of moles × 6.022×10^{23}

= $3 \times 6.022 \times 10^{23}$

= 1.806×10^{24}

Thus, number of molecules of N_2 is 1.806×10^{24}

d. 1 mol of H_2SO_4

Given: Number of moles = 1mol

Number of molecules = No. of moles × 6.022×10^{23}

= $1 \times 6.022 \times 10^{23}$

= 6.022×10^{23}

Thus, number of molecules of H_2SO_4 is 6.022×10^{23}

e. Given: Mass of water = 180g

Gram molecular mass of H_2O = 18g

To calculate the number of molecules, first we apply the formula:

$$\text{Number of gram molecules} = \frac{\text{mass in grams}}{\text{gram molecular mass (GMM)}}$$

$$\text{Number of gram molecules} = \frac{\text{mass of } H_2O}{\text{GMM of the } H_2O}$$

$$\text{Number of gram molecules} = \frac{180g}{18g}$$

Number of gram molecules = 10

Now, number of molecules = $10 \times 6.022 \times 10^{23}$

= 6.022×10^{24}

Thus, number of molecules of H_2O is 6.022×10^{24}

The arrangement of the samples in increasing order of the number of molecules in each is:

44.8 L of NH_3 at STP < 67.2 L of N_2 at STP < 20 g of He < 1 mol of H_2SO_4 < 180 g of water

2 B. Question

Examine the samples given:

a. 20 g of He

b. 44.8 L of NH_3 at STP

c. 67.2 L of N_2 at STP

d. 1 mol of H_2SO_4

e. 180 g of water What will be the ascending order of the total number of atoms in each sample?

Answer

Calculation of number of atoms in each:

a. Number of molecules = 3.011×10^{24} (calculated)

In He, there is only one atom

Thus, total number of atoms of He = 1 × Number of molecules

= 3.011×10^{24}

b. Number of molecules = 1.204×10^{24} (calculated)

In NH_3, there are four atoms

Thus, total number of atoms of NH_3 = 4 × Number of molecules

= $4 \times 1.204 \times 10^{24}$

= 4.8×10^{24}

c. Number of molecules = 1.806×10^{24} (calculated)

In N_2, there are two atoms

Thus, total number of atoms of N_2 = 2 × Number of molecules

= $2 \times 1.806 \times 10^{24}$

= 3.6×10^{24}

d. Number of molecules = 6.022×10^{23} (calculated)

In H_2SO_4, there are seven atoms

Thus, total number of atoms of H_2SO_4 = 7 × No. of molecules

= $7 \times 6.022 \times 10^{23}$

= 4.21×10^{24}

e. Number of molecules = 6.022×10^{24} (calculated)

In H_2O, there are three atoms

Thus, total number of atoms of H_2O = 3 × Number of molecules

= $3 \times 6.022 \times 10^{24}$

= 1.8×10^{25}

The arrangement of the samples in increasing order of the number of atoms in each is:

20 g of He < 67.2 L of N_2 at STP < 1 mol of H_2SO_4 < 44.8 L of NH_3 at STP < < 180 g of water

2 C. Question

Examine the samples given:

a. 20 g of He

b. 44.8 L of NH_3 at STP

c. 67.2 L of N_2 at STP

d. 1 mol of H_2SO_4

e. 180 g of water

What will be the masses of samples b, c and d?

Answer

Calculation of mass:

For 44.8 L of NH_3 at STP (b)

Number of moles = 2 (calculated in part (i)-b)

Now, we can calculate the mass of NH_3 by applying the formula given:

$$\text{Number of moles} = \frac{\text{Mass of } NH_3}{\text{Gram molecular mass of } NH_3}$$

We can write,

Mass of NH_3 = Number of moles × GMM of NH_3

Mass of NH_3 = 2 × 17g

Mass of NH_3 = 34g

Thus, mass of 44.8L of NH_3 at STP is 34g

For 67.2 L of N_2 at STP (c)

Number of moles = 3 (calculated in part (i)-c)

Now, we can calculate the mass of N_2 by applying the formula given:

$$\text{Number of moles} = \frac{\text{Mass of } N_2}{\text{Gram molecular mass of } N_2}$$

We can write,

Mass of N_2 = Number of moles × GMM of N_2

Mass of N_2 = 3 × 28g

Mass of N_2 = 84g

Thus, mass of 67.2 L of N_2 at STP is 84g

1 mol of H_2SO_4

Number of moles = 1

Now, we can calculate the mass of H_2SO_4 by applying the formula given:

$$\text{Number of moles} = \frac{\text{Mass of } H_2SO_4}{\text{Gram molecular mass of } H_2SO_4}$$

We can write,

Mass of H_2SO_4 = Number of moles × GMM of H_2SO_4

Mass of H_2SO_4 = 1 × 98g

Mass of H_2SO_4 = 98g

Thus, mass of 1 mol of H_2SO_4 is 98g

3 A. Question

In 90 gram of water

How many molecules are present?

Answer

Given: Mass of water = 90g

Gram molecular mass of H_2O = 18g

To calculate the number of molecules, first we apply the formula:

$$\text{Number of gram molecules} = \frac{\text{mass in grams}}{\text{gram molecular mass (GMM)}}$$

$$\text{Number of gram molecules} = \frac{\text{mass of } H_2O}{\text{GMM of the } H_2O}$$

$$\text{Number of gram molecules} = \frac{90g}{18g}$$

Number of gram molecules = 5

Now, number of molecules = $5 \times 6.022 \times 10^{23}$

= 3.01×10^{24}

Thus, number of molecules of 90 gm of water is 3.011×10^{24}

3 B. Question

In 90 gram of water

What will be the total number of atoms?

Answer

Number of molecules = 3.011×10^{24} (calculated)

In H_2O, there are three atoms

Thus, total number of atoms of H_2O = 3 × Number of molecules

= $3 \times 3.011 \times 10^{24}$

= 9.033×10^{24}

3 C. Question

In 90 gram of water

What will be the total number of electrons in this total number of particles?

Answer

Number of gram molecules = 5 (calculated in part a)

Now, 1 molecule of water contains:

1 × 8 electron of oxygen

2x1 electron of Hydrogen

Total 10 electrons per molecule.

So total number of electrons = Number of gram molecules × number of electron per molecule

Total number of electrons = 5 × 10

Total number of electrons = 50 moles of electrons

As we know 1 mole = 6.022×10^{23}

∴ 50 moles of electrons = $50 \times 6.022 \times 10^{23}$

= 3.01×10^{25} number of electrons

Thus, the total number of electrons = 3.01×10^{25}

4. Question

You are given 100 g of NaOH, 200 mL water, beakers and weighing balance. How will you prepare a 1 molar (1 M) solution of NaOH taking sufficient quantities from these?

Answer

Preparation of 1M solution of NaOH

$$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Volume in litres}}$$

As we know that 1 mole of NaOH has 40gm of mass.

Hence, if we want to prepare 1M NaOH solution:

i. First we need to weigh 40gm of NaOH in weighing balance.

ii. Pipette out 1L water from 200mL water and put in a beaker.

iii. Now, dissolve 40gm of NaOH in the beaker.

That's how 1M solution of NaOH is prepared.

5 A. Question

500 mL of a 1M solution of common salt is taken.

How many grams of common salt are dissolved in this?

Answer

Given: Volume of solution of NaCl (common salt) = 500mL

= 0.5L

Molarity of solution = 1M

$$\text{Molarity} = \frac{\text{Number of moles of NaCl}}{\text{Volume in litres}}$$

We can write,

Number of moles = Molarity × volume in litres

Number of moles = 1M × 0.5L

Number of moles = 0.5

Now, to find the mass in grams, apply the formula given:

$$\text{Number of moles} = \frac{\text{Mass of NaCl in grams}}{\text{Gram molecular mass of NaCl}}$$

Gram molecular mass of NaCl = GMM of Na + GMM of Cl

= 23g + 35.5g

= 58.5g

Therefore,

$$0.5 = \frac{\text{Mass of NaCl in grams}}{58.5\,\text{g}}$$

Mass of NaCl in grams = 0.5 × 58.5g

Mass of NaCl in grams = 29.25g

Thus, 29.25 grams of common salt are dissolved.

Note: If one litre of the solution contains 1mol of solute, it is called 1M (molar) solution.

5 B. Question

500 mL of a 1M solution of common salt is taken.

If the solution is diluted with water to a volume of 2 L, what will be the molarity?

Answer

If the solution is diluted with water to a volume of 2 L, the molarity will be:

$$\text{Molarity} = \frac{\text{Number of moles of NaCl}}{\text{Volume in litres}}$$

As number of moles = 0.5 (calculated in part a)

Volume in litres = 2L (given)

$$\therefore \text{Molarity} = \frac{\text{Number of moles of NaCl}}{\text{Volume in litres}}$$

$$\text{Molarity} = \frac{0.5}{2\text{L}}$$

Molarity = 0.25M

Thus, the molarity will be 0.25M