Calculations using the mole concept

Objectives:

To introduce the concept of the mole as the unit of measurement for amounts of compounds ; atoms ; molecules and ions .

Introduction:

- -A mole of any substance : is the amount of the substance which contains a number of particles(atoms ; molecules ; etc.)equal to Carbon atoms in 12 grams of Carbon-12 . it is the relative atomic mass expressed in grams .

e.g.

One mole of Carbon-12 is 12 grams .

One mole of Sodium-23 is 23 grams .

- - The number of particles in one mole of any substance is equal to *Avogadro's constant* .

A mole of any substance contains the same number of particles : ***Avogadro's constant*** (6.02×10^{23}) .

e.g.

1 mole of Carbon contains 6.02×10^{23} particles .

1 mole of Sodium contains 6.02×10^{23} particles .

- -***The Molar Mass*** of a substance : is the mass of one mole ***(M_r)*** **.** It is the relative mass in grams .

e.g.

M_r of Na =23 grams

M_r of NaOH =23+16+1=40 g .

No. of moles = mass in grams /molar mass

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Example :

1-How many moles of CO_2 molecules are present in 11g of CO_2 ؟

By formula :

Number of moles = no. of grams/mass of 1 mole.

=11/44

=0.25 mole.

By dimentional analysis :

1 mole ------ 44g

1 mole/44g = 44g/44g = 1

Unit factor = 1 mole/44g

11g x1 mole/44g =0.25 mole.

2-What is the mass of 2 moles of Ethanol molecules؟ (Ethanol:C_2H_5OH) .

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3-How many atoms are there in 5 moles of Carbon؟

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Moles for Gases :

Definition : One mole of molecules of any gas Occupies : 24L at room temp. and pressure or 22.4L at S.T.P.(0^{O}C & 273 K) .

No. of moles (at R.T.P) =volume/24L .

No. of moles (at S.T.P) =volume/22.4L .

Molar Solutions:

Is a solution of a substance where one litre contains one mole of the substance dissolved in it .

Molarity =No. of moles x1000 Cm3/Vol. used(Cm3)
=Mass/RAM x1000 Cm3/Vol. used(Cm3)

Exercises:

Complete :

1- A mole of Oxygen atom(O) contains …….atoms.
2- A mole of Oxygen molecule (O_2) contains …….. molecules.
3- A mole of Oxygen molecule (O_2) contains …….. atoms.
4- A mole of Oxygen atom(O) weights ……. g.
5- A mole of Oxygen molecule (O_2) weights …… g.

Change to the power of ten :

1- 520000
2- 0.000874
3- $(0.01)^2$
4- 2^4

Express as numbers without power of ten :

1- 9.6×10^5

2- 6×10^{-3}
3- 22×10^{4}
4- 10^{-6}

Convert :

1- 5.31 moles of C to grams of C (R.A.M. = 12).
2- 5 moles of Cl^2 to grams of Cl^2 (R.A.M. = 35.453).
3- 100g. of Fe to moles of Fe(R.A.M. = 55.84).
4- 40g. of N2 to moles of N2 (R.A.M. =14).
5- 30ml Hg (d=13.6g/ml)to moles of Hg (R.A.M.= 200.59).