



UGC-NET

Environmental Science

NATIONAL TESTING AGENCY (NTA)

PAPER – 2 || VOLUME – 2

**FUNDAMENTAL OF ENVIRONMENTAL
CHEMISTRY & ENVIRONMENTAL
BIOLOGY**



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UNIT - 2

ENVIRONMENTAL CHEMISTRY

* Acid	Base
→ Acid are proton donors / electron pair acceptors	* Bases are proton acceptors / electron pair donors.
→ Acids are able to increase the H^+ ion concentration in an aqueous solution	* Bases are able to increase the OH^- ion concentration in an aqueous solution.
→ Acids have a PH value < 7	* Bases turn red litmus paper into blue.
→ Acids turn blue litmus paper into Red.	* Bases have a PH value > 7
→ Acids react with bases to form salts in an aqueous medium	* Bases react with Acids to form salts in an aqueous medium.
→ Acids taste sour.	* Bases taste soapy

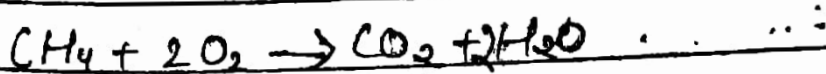
	Acids	Bases
Hard	H^+ , Na^+ , K^+ , Mg^{2+} , Ca^{2+} , Al^{3+} , Cr^{3+} , Co^{3+} , Fe^{3+} , Ti^{4+} , Zr^{4+} , Cy^{6+}	NH_3 , RNH_2 , H_2O , OH^- , O^{2-} , F^- , Cl^- , NO_3^- , ClO_4^- , SO_4^{2-} , CH_3COO^-
Borderline	Fe^{2+} , Co^{2+} , Ni^{2+} , Cu^{2+} , Zn^{2+} , Sn^{2+} , Pb^{2+} , Cu^+ , Ag^+ , Au^+ , Pd^{2+} , Pt^{2+} , Pt^{4+} , M^0 (Metal atoms)	Br^- , NO_2^- , SO_3^{2-} , H^- , CN^- , C_2H_4 , CO , R_3H , SeO_3^{2-}

Stoichiometry is the calculation of reactants and products in chemical reaction.

Stoichiometry is founded on the laws of Conservation of mass where the total mass of the reactants equals the total mass of the products, leading to the insight that the relations among quantities of reactants & products typically form a ratio of positive integers.

This means that if the amount of the separate reactants are known, then the amount of the product can be calculated.

Conversely, if one reactant has a known quantity and the quantity of the products can be empirically determined, then the amount of the other reactants can also be calculated.



Here one molecule of methane react with two molecules of oxygen gas to yield one molecule of CO_2 and two molecules of water.

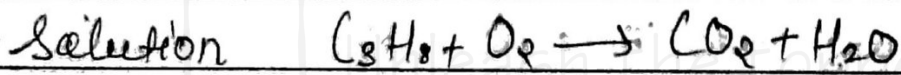
This particular chemical equation is an ex of complete combustion.

* A mole of substance or a mole of particle is defined as exactly 6.023×10^{23} particles, which may be atoms molecules ions or electrons.

* In short for particles $1 \text{ mol} = 6.023 \times 10^{23}$

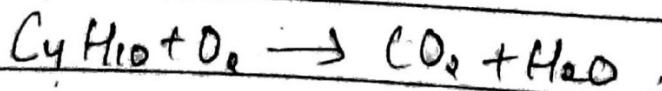
* It depends upon no. of moles.

① How many oxygen molecules will be required for complete burning of 1 molecule of C_3H_8 .



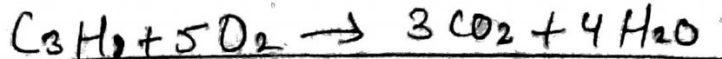
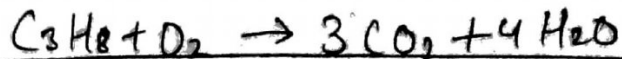
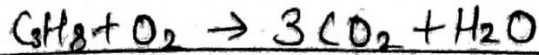
② How many oxygen molecules will be required for complete combustion of butane.

Solⁿ

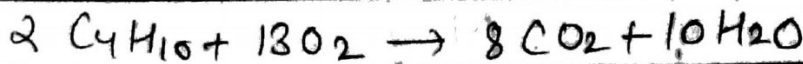
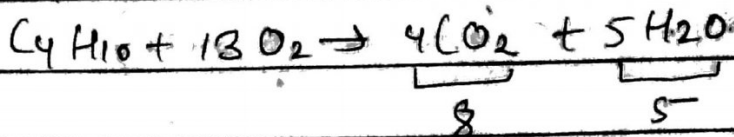
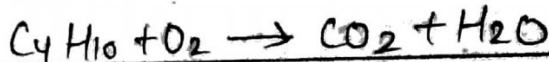
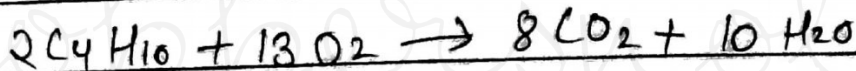
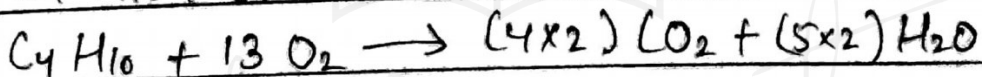
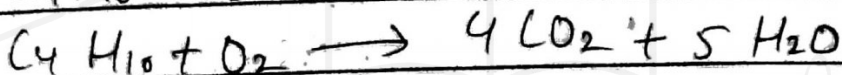
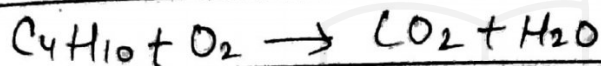




First \rightarrow Balance C \rightarrow H \rightarrow O



5 O_2 molecules.



$$2x + y = 13$$

$$x + 2y = 14$$

=

Molarity

Molarity is defined as the amount of moles of a compound dissolved in an amount of solvent (usually water).

* It can be solved with the equation

$$\text{Molarity (M)} = \frac{\text{moles solute}}{\text{liters of solution}}$$

Formula:-

$m = \text{mass (g)}$

$n = \text{no. of moles (mol)}$

$M = \text{Molar mass (g/mol)}$

$n = \frac{m}{M}$

$$\text{Molarity} = \frac{\text{No. of moles of solute}}{\text{Volume of sol. in litre}}$$

$$\text{No. of moles} = \frac{\text{Given wt}}{\text{molecular wt.}}$$

$$\text{Molarity} = \frac{\text{Given wt}}{\text{molecular wt}} \times \frac{1000}{\text{Volume of solution in l}}$$

* Calculate the molarity when 3 moles of HCl are dissolved in 200 ml of water?

Solution : no. of moles / volumes in litre

$$\begin{aligned} &= \frac{200 \text{ ml}}{1000} = 0.2 \\ &= \frac{3}{0.2} \\ &= 15 \text{ M. } \checkmark \end{aligned}$$

$\frac{200}{1000} = 0.2$

* Calculate the molarity when 18 g of NaOH is dissolved in 200 ml of water.

Solution:- $\text{NaOH} = 23 + 16 + 1 = 40$

$$\text{No. of moles} = \frac{\text{given wt}}{\text{molecular wt}} \\ = \frac{18}{40} = 0.45$$

$$\text{Volume} = 200 \text{ ml} = 0.2 \text{ l}$$

$$\text{Molarity} = \frac{0.45}{0.2} \\ = \underline{\underline{2.25 \text{ M}}}$$

$$\text{given wt} = 18$$

$$V = \frac{200}{1000} = 0.2 \text{ l}$$

$$\text{Normality} = \frac{\text{No. of gram equivalent}}{\text{Volume of soln in litre}}$$

$$\text{No. of gram equivalent} = \frac{\text{Given wt}}{\text{Equivalent wt}}$$

$$\text{Equivalent wt} = \frac{\text{Molecular wt}}{\text{2-factor/valency}}$$

Relation b/w N & M

$$\text{Normality} = \text{Molarity} \times \text{2-factor}$$

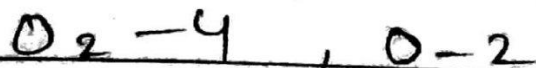
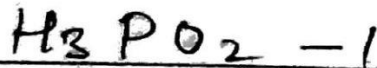
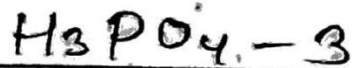
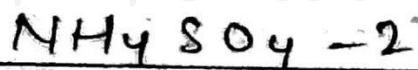
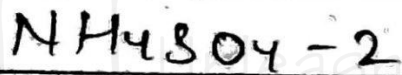
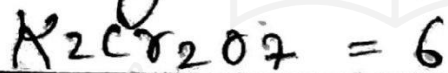
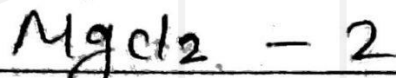
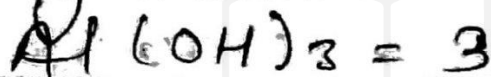
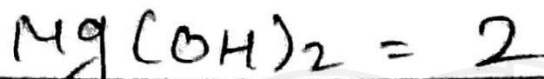
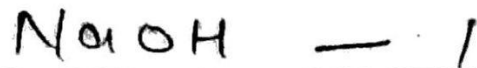
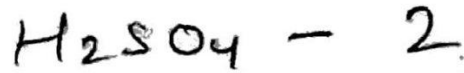
Relation b/w n & no. of gram equivalent

$$\text{no. of gram equivalent} = n \times 2$$

$$N = \frac{\text{wt of solute in gram}}{\text{Equivalent mass} \times \text{Volume in litre}}$$

- Relation b/w normality & molarity
 - $N \times \text{Eq. wt} = \text{Molarity} \times \text{Molar mass}$
 - $N = \text{Molarity} \times \text{Valency}$
 - $N = \text{Molarity} \times \text{no. of } H^+ \text{ or } OH^- \text{ ions}$

Z - FACTORS :-



1 PPM (part per million) = 1 mg/L

* 1 ppm is equivalent to 1 milligram of something per liter of water (mg/L) or 1 milligram of something per kg soil (mg/kg)

1 PPB (part per billion) = 1 μ g/L

* 1 PPB equal 1 μ g of substance per kg of solid (μ g/kg). PPB (or PPM) is also sometimes used to describe small

concentrations in water, in which case 1 PPB is equivalent to 1 μ g/L

$$* 1 \text{ PPM} = 1/10^6 = 10^{-6}$$

$$* 1 \text{ PPB} = 1/10^9 = 10^{-9}$$

So

$$* 1 \text{ PPM} = 1000 \text{ PPB}$$

$$* 1\% = 10,000 \text{ PPM}$$

$$* 1 \text{ PPM} = 0.0001\%$$

PPM TO MOLARITY

Convert PPM to gram based or milligram based concentration

PPM = 1 mg solute per liter soln or

PPM = 0.001 gram per liter soln.

eg:- wt is the Molarity of 400 PPM Ca ions in a aqueous CaCO_3 soln.

using the 0.001 g/L. Conⁿ :

$$400 \text{ PPM} \times 0.001 \text{ g/L} = 0.4 \text{ g/L}$$

or Divide 400 mg by 1000 to get g/L = 0.4 g/L

Now divide by At. mass of Ca to get Molarity.

$$0.4 \text{ g/L divided by } 40 \text{ g/mol}$$

$$= 0.01 \text{ M}$$

$$\text{Concentration} = 400 \text{ P.P.m}$$

$$1 \text{ P.P.m} = \text{mg/l}$$

$$\text{Conc:- } 400 \text{ mg/l}$$

$$1 \text{ gram} = 1000 \text{ mg}$$

$$1 \text{ mg} = \frac{1}{1000} \text{ gram}$$

$$\text{Conc:- } \frac{400}{1000} \text{ g/l}$$

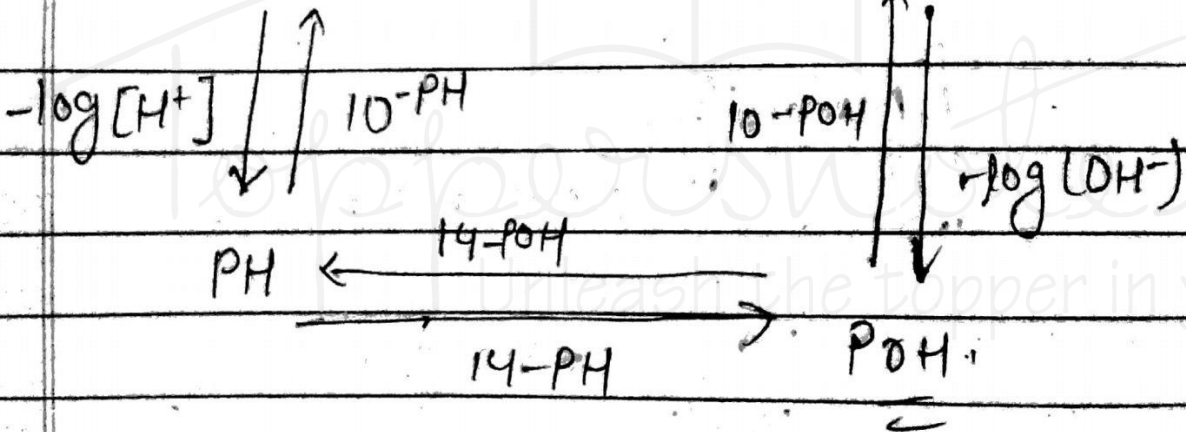
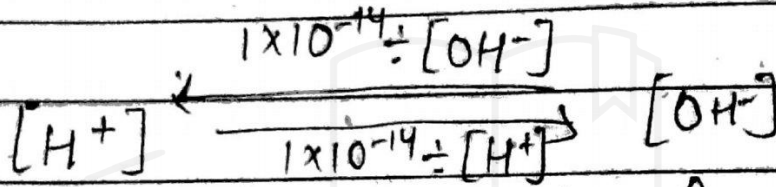
$$= 0.4 \text{ g/l}$$

$$\text{Molarity} = \frac{\text{Given wt}}{\text{Molecular wt}}$$

$$= \frac{0.4}{40 \times 1000} = 0.01 \text{ M}$$

$$pH + pOH = 14$$

$$K_w(\text{ionic product}) = 10^{-14}$$



LOG VALUES

$$\log 1 = 0$$

$$\log 2 = 0.3010$$

$$\log 3 = 0.4771$$

$$\log 4 = 0.6020$$

$$\log 5 = 0.6989$$

$$\log 6 = 0.7781$$

$$\log 7 = 0.8450$$

$$\log 8 = 0.9030$$

$$\log 9 = 0.9542$$

$$\log 10 = 1$$

$$\log 100 = 2$$

$$\log 1000 = 3 \text{ : so on.}$$

$$x = m \times n$$

$$\log x = \log (m \times n)$$

$$\log x = \log m + \log n$$

$$x = m/n$$

$$\log x = \log (m/n)$$

$$\log x = \log m - \log n$$

$$\log x = \log m^n$$

$$\log x = n \log m$$