Toppersnotes
Unleash the topper in you

UGC-NET

Environmental Science

NATIONAL TESTING AGENCY (NTA)

PAPER – 2 || VOLUME – 2

FUNDAMENTAL OF ENVIRONMENTAL CHEMISTRY & ENVIRONMENTAL BIOLOGY

SIERRA INNOVATIONS

CONTENT

UNIT- 2

Environmental Chemistry Fundamental Environmental Chemistry

Water Chemistry Pollution

Soil Order with Defining Characteristics

Tertiary Treatment

Soil Chemistry

UNIT- 3

Environmental Biology

Ecology

Evolution

Population Ecology

Biogeochemical Cycle Nutrient Cycle

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+}, Cr^{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_2S, $S_2O_3^{2-}$

Toppersnotes
Unleash the topper in you

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

Stoichiometry is founded on the law 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

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

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 eg 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 mol = 6.023×10^{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.

Solution $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$

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

Soln

$C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$.

$C_3H_8 + O_2 \rightarrow CO_2 + H_2O$

first → Balance C → H → O

$C_3H_8 + O_2 \rightarrow 3CO_2 + H_2O$

$C_3H_8 + O_2 \rightarrow 3CO_2 + 4H_2O$

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

5 O_2 molecules.

$C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

$C_4H_{10} + O_2 \rightarrow 4CO_2 + H_2O$

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

$C_4H_{10} + 13O_2 \rightarrow (4\times2)CO_2 + (5\times2)H_2O$

$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$

$C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

$C_4H_{10} + 13O_2 \rightarrow \underbrace{4CO_2}_{8} + \underbrace{5H_2O}_{5}$

$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$

$2x + y = 13$

$x + 2y = 14.$

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

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

Formula:-

m = mass (m)

n = no. of moles (mol)

M = Molar mass (g/mol)

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

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

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

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

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

Solution : no. of moles / volumes in litre

= 200 ml = 0.2 l

= 3 / 0.2

= 15 M. ✓

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

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

Solution :- NaOH = 23 + 16 + 1 = 40

No. of moles = given wt / molecular wt

= 18/40 = 0.45

Volume = 200 ml = 0.2 l

Molarity = 0.45 / 0.2

= 2.25 M.

given wt = 18

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

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

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

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

Relation b/w N.s M

Normality = Molarity × 2-factor

Relation b/w n's no. of gram equivalent

no. of gram equivalent = $n \times 2$

n

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

- Relation b/w normality s 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 :-

H_2SO_4 – 2

HCl – 1

NaOH – 1

$Mg(OH)_2$ = 2

$Al(OH)_3$ = 3

$MgCl_2$ – 2

$K_2Cr_2O_7$ = 6

Na_2CO_3 = 2

NH_4SO_4 – 2

NH_4SO_4 – 2

H_3PO_4 – 3

H_3PO_3 – 2

H_3PO_2 – 1

H – 1 , H_2 – 2

O_2 – 4 , O – 2

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

* One 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 ug/L

* 1 PPb equal 1 ug of substance per kg of solid (ug/kg). PPb (or PPbm) is also sometimes used to describe small concentrations in water, in which case 1 PPb is equivalent to 1 ug/l

* 1 PPm = $1/10^6 = 10^{-6}$.
* 1 PPb = $1/10^9 = 10^{-9}$.

So

* 1 PPm = 1000 PPb.
* 1% = 10,000 PPm
* 1 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 CaCO3 soln.

using the 0.001 g/L conv:
400 PPM x 0.001 g/L = 0.4 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 g/L divided by 40 g/mol
= 0.01 M/2.

Concentration = 400 PPm

1 PPm = mg/l

Conc :- 400 mg/l

1 gram = 1000 mg

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

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

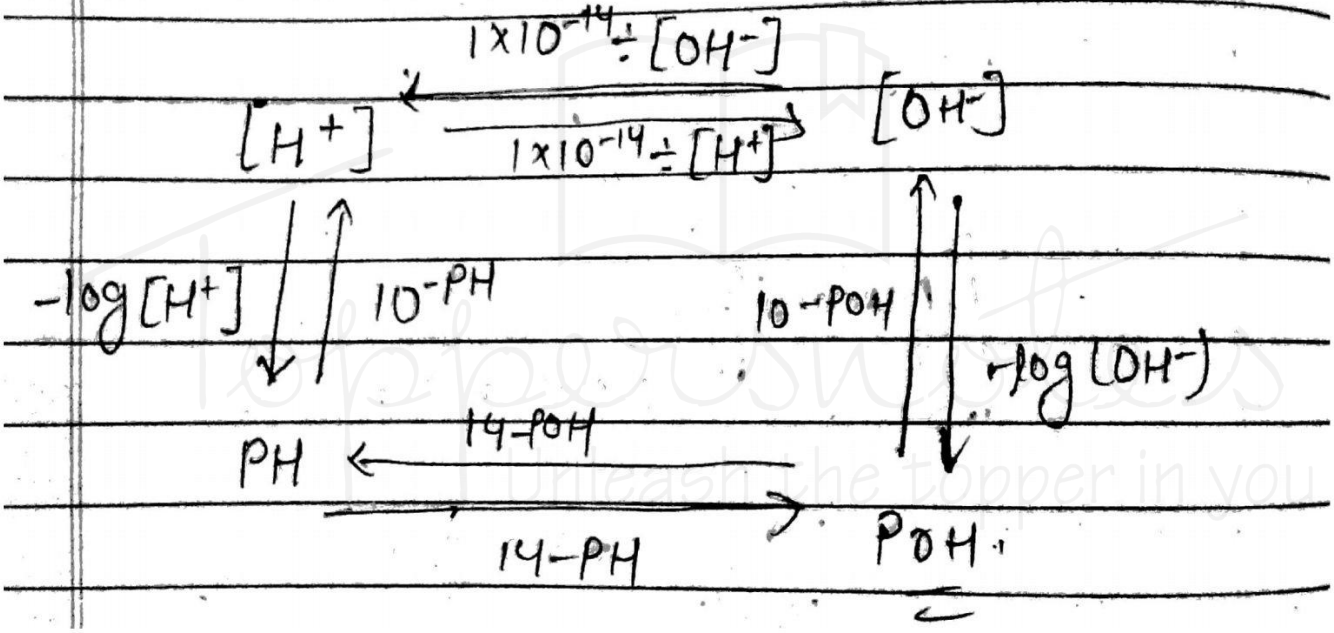
= 0.4 g/l

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

$\frac{=0.4}{40XX}$ = 0.01 M.

$pH + pOH = 14$

Kw (Ionic Product) $= 10^{-14}$



LOG VALUES

$\log 1 = 0$

$\log 2 = 0.3010$

$\log 3 = 0.4771$

$\log 4 = 0.6020$

$\log 5 = 0.6989$

$\log 6 = 0.7781$

$\log 7 = 0.8450$

$\log 8 = 0.9030$

$\log 9 = 0.9542$

$\log 10 = 1$

$\log 100 = 2$

$\log 1000 = 3$ and so on.

$x = m \times n$

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

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

$x = m/n$

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

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

$\log x = \log m^n$

$\log x = n \log m$.