

(2) State Mendeleev's periodic law. Explain the Mendeleev's periodic table with its limitations.

or

Define Mendeleev's periodic table. What are its anomalies?

or

Define Mendeleev's periodic table. What are the main defects of Mendeleev's periodic table?

→ The law states: "The physical and chemical properties of the elements are periodic function of their atomic weights."

The main defects of Mendeleev's periodic table are as follows:

(i) Position of hydrogen in the table is controversial. The position of hydrogen is not clear.

(ii) Metal and non-metal are not separately placed.

(iii) Lanthanides and Actinides are not separated from the main body of the periodic table.

(Cf., to Lu, fourteen elements known as lanthanides)

(iv) Th to Lu, fourteen elements known as actinides.

(v) Elements with higher atomic masses are placed before that of lower atomic masses.

(vi) Certain chemically similar elements like copper and mercury are placed in different groups while some other dissimilar elements like copper, silver and gold have been placed in the same group.

3. Faraday's Law of Electrolysis

(i) Faraday's first law of electrolysis

→ The mass of any substance deposited or dissolved at any electrode during electrolysis is directly proportional to the quantity of electricity passed through the solution.

i.e. $W \propto Q$, but $Q = I \times t$

where, Z is the electrochemical equivalent of the substance.

$I = 1 \text{ ampere}$ ($\therefore Z = W$)

$t = 1 \text{ second}$

(ii) Faraday's second law of electrolysis

→ "The masses of different substances liberated or dissolved by the same amount of electricity are proportional to their equivalent masses."

Explanation

Consider 3 cells containing HCl , AgNO_3 and CuSO_4 solutions are connected in series.

Mass of hydrogen = Mass of silver = Mass of copper

$E.W. \text{ of hydrogen} : E.W. \text{ of silver} : E.W. \text{ of copper}$

$\therefore \text{Mass of hydrogen} = \text{Mass of silver} = \text{Mass of copper}$

$1.08 : 108 : 33.75$

(vi) $V.D = \text{wt. of 1 molecule of the gas}$

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(vii) $V.D = \text{wt. of 1 molecule of the gas}$

$2 \times \text{wt. of 1 atom of hydrogen}$

Since, hydrogen is diatomic

(viii) $V.D \times 2 = \text{wt. of 1 molecule of the gas}$

$\text{wt. of 1 atom of hydrogen}$

(ix) $2 \times V.D = \text{molecular weight of the gas}$

thus, molecular weight of a gas is twice of its vapour density.

(x) Pauli's Exclusion Principle

→ It states that "No two electrons in an atom can have all the four quantum numbers same." For example, in $1s$ orbital of Helium (He) atom, there are two electrons.

→ According to the concept of quantum numbers and Pauli's exclusion principle their quantum numbers are

Electron	n	l	m	S	Set of values of quantum numbers n, l, m, s
Electron 1	1	0	0	$+\frac{1}{2}$	$(1, 0, 0, +\frac{1}{2})$
Electron 2	1	0	0	$-\frac{1}{2}$	$(1, 0, 0, -\frac{1}{2})$

(6) What are the defects of Rutherford's atomic model? (Rutherford atomic theory drawback)

→ The defects of Rutherford's atomic model are;

(i) It could not account for the stability of an atom.

(ii) It could not account for the formation of discontinuous spectra of hydrogen.

To overcome the drawbacks of Rutherford's atomic model, Niels Bohr proposed a model of an atom. It deals with atomic stability and spectra of atom in light of Planck's quantum theory of radiation.

(write down) (basis) What are the main postulates of Bohr's atomic model?

→ The main postulates of Bohr's atomic model are,

(i) The electron revolves around the nucleus in a fixed circular path, called an orbit. As long as an electron remains in a particular orbit, it neither loses nor gains energy. This creates atomic stability.

(ii) Electrons revolve only in those orbits in which angular momentum of an electron is an integral multiple of $\frac{h}{2\pi}$.

i.e. $mvR = nh$

where, $m = \text{mass of the electron}$ $R = \text{radius of the orbit}$ $n = 1, 2, 3, 4, \dots$

$v = \text{velocity}$ $h = \text{Planck's constant}$

(1) Define equivalent weight.

→ It is the number of parts by weight of the substance that combines or displaces 1.008 part by weight of hydrogen, 8 parts by oxygen and 35.5 parts by weight of chlorine.

Find out equivalent weight of following:

(i) H_2SO_4

Soln. Molecular weight of $= 2 \times 1 + 32 + 6 \times 4$

$= 98$

Basicity of $= 2$

$\therefore \text{Equivalent wt. of H}_2\text{SO}_4 = \frac{98}{2} = 49$

(ii) Ca(OH)_2

Soln. Molecular weight $= 40 + (16+1) \times 2$

$= 40 + 17 \times 2$

$= 40 + 34$

$= 74$

Acidity = 2

$\therefore \text{Equivalent wt. of Ca(OH)}_2 = \frac{\text{Molecular wt}}{\text{Acidity}}$

$= \frac{74}{2}$

$= 37$

(2) Molarity (M)

→ It is defined as the number of gram-moles of solute present in one litre of the solution. It is represented by M.

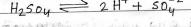
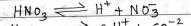
i.e. Molarity (M) = Number of gram moles of solute / Volume of solution in litre

define

(6) Explain acid and base according to Arrhenius concept with suitable examples.

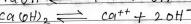
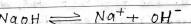
(a) Arrhenius Acid

→ An acid is a hydrogen compound which in aqueous solution gives hydrogen ions H^+ ions.



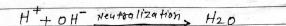
(b) Arrhenius Base

→ A base is a hydroxide compound which in aqueous solution gives hydroxide ions OH^- ions.



(c) Neutralization reaction

→ The process of neutralization results from the union of hydrogen ions with hydroxide ions to form water molecules.



(5) Quantum Numbers

→ The set of four numbers from which we can get complete information of an electron in an atom. The four quantum numbers are;

(d) Principle quantum number (n)

→ It represents the main shell (K, L, M, \dots) and tells about the size and energy of an electron.

(ii) Azimuthal quantum number (l)

→ It represents number of sub-shells present in a main shell and tells about the shape of a sub-shell.

(iii) Magnetic quantum number (m_l)

→ It represents number of orbital in a sub-shell and tells about the orientation of the orbital.

(iv) Spin quantum number (s)

→ It tells the direction of spin of electron i.e. clockwise $+\frac{1}{2}$ or $-1/2$ or anticlockwise $-\frac{1}{2}$.

(6) Aufbau principle

→ According to this principle, the electrons in an atom are so arranged that they occupy the orbitals in the order of their increasing energy.

Some rules

(i) The orbitals having the lowest value of $(n+l)$ are occupied first by electron.

(ii) When two orbitals have the same values of $(n+l)$, the orbital having the lower value of n is filled first.

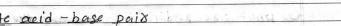
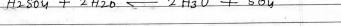
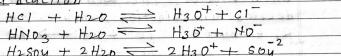
(13) Define acid and base on the basis of Bronsted concept. What is conjugate acid-base pair?

or

Lowry and Bronsted concept of acid and base

→ According to this theory, "An acid is a substance which has tendency to donate one or more protons and a base is a substance which has a tendency to accept protons given by acids in solution."

Consider a reaction



Conjugate acid-base pair

→ Such an acid and a base which differ by a proton and are formed one from the other by the gain or loss of a proton are said to form a conjugate acid-base pair.

for e.g. $\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{HSO}_4^-$

Acids Bases Acid Bases

(1) Write short notes

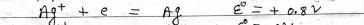
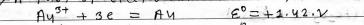
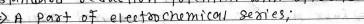
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1. Electrochemical series or Activity series

→ The arrangement of various elements in order of increasing values of standard reduction potentials is called electrochemical series.

→ The standard oxidation potential is equal to standard reduction potential with opposite sign.

→ A part of electrochemical series:



Positive sign of E° indicates that the substance has greater tendency to reduce than hydrogen.

2. Buffer solution

→ A solution whose pH almost remains constant even when a few drops of an acid or base are added to it is called buffer solution.

→ Blood is a buffer with pH about 7.4.

→ Buffer solution are two types they are:-

(i) Acidic buffer

→ The solution of weak acid and salt of this weak acid with a strong base is called acidic buffer.

for e.g. $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$

Acids Bases Acid Bases

(ii) Basic buffer

→ The solution of weak base and salt of this weak base with a strong acid is called basic buffer.

for e.g. $\text{NH}_3 \text{OH} + \text{NH}_4\text{Cl}$

Acids Bases Acid Bases