(5) state and explain Dulong's and Petit's law in detail.

OR,

How can you determine the atomic weight of solid element using Dulong's and Petit's Method?

⇒ According to Dulong's and Petit's law,

"Atomic Weight × specific heat = 6.4 (Approx)"

steps in the determination of atomic weight

(i) Equivalent weight of the solid element is determined by a suitable method.

(ii) specific heat of the element is determined.

(iii) Approximate atomic weight of the element is calculated from Dulong and Petit's law.

$$\text{Approx. at. wt.} = \frac{6.4}{\text{Sp. heat}}$$

(iv) Approximate valency of the element is calculated by use of following relation.

$$\text{Approx. Valency} = \frac{\text{Approx. at. wt}}{\text{Equivalent weight}}$$

(v) Lastly, correct atomic weight of the element is calculated by following relation:

$$\text{correct at. wt.} = \text{Eq. wt.} \times \text{Exact valency}$$

(4) Define Avogadro's hypothesis. Show that the molecular weight of the compound is twice of it's vapour density.

⇒ According to avogadro, "Equal volumes of all gases measured under similar conditions of temperature and pressure contain equal number of molecules.

determination of relationship between Molecular weight and vapour density

Prove that Molecular weight of volatile substance is twice of it's vapour density

⇒ vapour density (V.d) of a gas can be expressed as =

$$\text{V.D.} = \frac{\text{wt. of 'V' volumes of the gas}}{\text{wt. of 'V' volumes of hydrogen}}$$

(measured under similar condition of temperature and pressure)

Applying Avogadro's hypothesis if 'V' volumes of gases contain 'n' Molecules, the above expression can be written as

$$\text{V.D.} = \frac{\text{wt. of 'n' Molecules of the gas}}{\text{wt. of 'n' Molecules of hydrogen}}$$

(2) State Modern periodic law. Write anomalies of Modern periodic table.

OR,

State Modern periodic law. What are the main defects of Modern periodic table.

⇒ It state that: "The physical and chemical properties of the elements are the periodic function of their atomic numbers."

The main defects of Modern periodic table are as follows :-

Anomalies of Modern periodic table

There is no anomalies pair in Modern periodic table because anomalies pairs of Mendeleev's periodic table are removed by Modern periodic law. Therefore, there are anomalies pairs in Mendeleev's periodic table only.

⇒ The advantages of this law

⇒ How does it explain to correct Mendeleev's periodic table.

(i) The position of Ar & K, Ni & Co, etc has been made correct by this law.

(ii) The misfits like position of alkali Metals and coinage Metals in the same group have been removed by separation of Sub-groups.

(iii) position of isotopes is fully justified by this law.

(iv) The elements are divided into S, P, d, & f Blocks which have made the study simpler.

limitations of Arrhenius Theory

(1) Arrhenius theory does not explain the nature of hydrogen ion. actually, hydrogen ion does not exist independently. it combines with water Molecule to form hydronium ion.

$$H^+ + H_2O \longrightarrow H_3O^+$$

(Hydronium ion)

(2) Arrhenius theory does not give the satisfactory explanation for the acidity of $AlCl_3$, $FeCl_3$, etc. and basicity of NH_3.

(3) This theory does not explain the acidic behaviour of carbon dioxide.

$$CO_2 + 2NaOH \longrightarrow Na_2CO_3 + H_2O$$

(6) define acid and base in terms of Lewi's concept.

Ans ⇒ Lewis acid

⇒ Lewis acids are those species which can accept lone pair of electrons to form coordinate covalent bond. for example :- H^+, Na^+, Ca^{++}, Ag^+, Cu^{++} etc. (Lewis acid is also called as electrophile.)

Lewi's Base

⇒ Lewis base are those species which can donate electron pair to form coordinate covalent bond. for example :- Cl^-, SO_4^-, OH^-, CN^-, NH_2^- etc.

(2) Molecular weight

⇒ It is the mass of a Molecule of a substance with respect to the mass of $(\frac{1}{12})^{th}$ of an atom of C-12 isotopes.

$$\text{Molecular wt. of substance} = \frac{\text{absolute wt of a Molecule of the substance}}{\frac{1}{12} \times \text{wt. of an atom of } C^{12}\text{-isotope of carbon.}}$$

for eg :- The Molecular masses of CO_2 an NaCl are 44 amu and 58.5 amu respectively.

(3) Gram Molecular weight or Gram Equivalent

⇒ Equivalent weight of any substance expressed in gram is called gram equivalent.

$$\text{No. of gram Equivalent} = \frac{\text{wt. of substance in gram}}{\text{Equivalent weight}}$$

(4) Normality (N)

⇒ It is defined as the number of gram-equivalents of solute present in one litre of the solution. It is represented by N.

i.e., $$\text{Normality} = \frac{\text{Number of gm equivalents of solute}}{\text{volume of solution in litre}}$$

(iii) When an electron absorbs energy, it's transition takes place from lower to higher orbits and absorption spectra is formed. when an electron jumps from higher orbits to lower, it radiates energy in the form of emission spectra.

$$E_2 - E_1 = hf$$

Where,

E_1 is the energy in state-1

E_2 is the energy in state-2

h = plank's constant

f = frequency of radiation.

(7) Dalton's atomic theory

⇒ The main points of Dalton's atomic theory are

(1) All matter consist of extremely small tiny indivisible particles called 'atoms'

(2) Atoms of the same element are identical in all respects.

(3) Atoms of the different element are entirely different and have different properties.

(4) Atoms can not be destroyed, created or transformed into atoms of other elements.

(5) Atoms combine together in simple whole number ratio to give compound atoms.

(7) Define valence electrons. what are the assumptions of electronic theory of valency.

Ans ⇒ valence electrons

The electron present in the valence (outermost) shell of any atom are called valence electrons. These electrons participate in chemical combination.

The assumptions of electronic theory of valency are as follows :-

(i) only the valence electrons participate in chemical combination.

(ii) Number of valence electrons determines the capacity of atoms to take part in chemical combination.

(iii) Every element has tendency to acquire the nearest inert gas configuration which is considered as stable configuration.

(iv) The combination of atoms takes place by transfer or Mutual sharing or donating one or more valence electrons.

(v) The attractive forces which hold various constituents (atoms, ions) together in different chemical species are called chemical bond.

(3) Rusting of Iron

⇒ When iron is exposed to moist air, it gets covered with a layer of brown powdery material. The formation of brown powdery material on the surface of iron in the presence of moist air is called rusting of iron.

⇒ Rust mainly consists of hydrated ferric oxide ($Fe_2O_3 \cdot x H_2O$ (s))

$$4Fe(s) + 3O_2(g) + x H_2O \longrightarrow \underset{\text{rust}}{2Fe_2O_3 \cdot x H_2O(s)}$$

iron, oxygen, water from air

(4) Hund's rule

⇒ According to this rule, "The pairing of electrons in the orbitals of a particular sub-shell (P, d or f) does not take place until all the orbitals of the sub-shell are singly occupied. Moreover, the singly occupied orbitals must have the electrons with parallel spins.

For example :-

Hydrogen (H) = $1s^1$ = $\overset{1s}{\boxed{\uparrow}}$

Helium (He) = $2s^2$ = $\overset{2s}{\boxed{\uparrow\downarrow}}$

Lithium (Li) = $1s^2, 2s^1$ = $\overset{1s}{\boxed{\uparrow\downarrow}}\ \overset{2s}{\boxed{\uparrow}}$

(8) oxidation

⇒ oxidation is defined as the chemical process which involves the loss of electrons and increase in oxidation number.

for example :- $Fe \longrightarrow Fe^{++} + 2e$

$2Br^- \longrightarrow Br_2 + 2e$

Reduction

⇒ Reduction is defined as the chemical process which involves the gain of electrons and decrease in oxidation number.

for example :- $Fe^{++} + 2e \longrightarrow Fe$

$Br_2 + 2e \longrightarrow 2Br^-$

(9) What are radicals ? How are they classified ?

⇒ Atom or group of atoms carrying charge which acts as single unit in the chemical reaction is called radicals.

Classification

(i) on the basis of charge, they are divided into two parts.

(a) Electropositive radicals

⇒ They have **positive** charge. for eg :- Na^+, NH_4^+, etc.

(b) Electronegative radicals

⇒ They have negative charge. for eg :- Cl^-, SO_4^-, etc

(ii) on the basis of number of atoms present, they are classified into two groups.

(a) Monoatomic radicals

⇒ They contain single atom. for eg :- Na^+, Cl^- etc.

(b) polyatomic radicals

⇒ They contain more than one atom. for eg :- NH_4^+, SO_4^-, etc