Chapter 04....Liquids And Solids

SHORT QUESTION WITH ANSWERS

Q.1 what is difference between

(i) Intermolecular forces and intermolecular forces
(ii) Polar molecules and non–polar molecules
(iii) Induce and dipole and instantaneous dipole
(iv) Dipole

Ans. (i) Intermolecular Forces:

The forces of attraction between two different atoms ions and molecules are **called intermolecular** forces.

For example H—Cl……H--Cl…….H--Cl

Intermolecular Forces:

The forces of attraction between two atoms or group of atoms present with in the same molecule, **are called intermolecular forces**.e.g covalent bond ,ionic bond etc

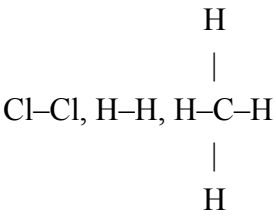
(ii) Polar molecules:

A molecule which has partial +ve and partial –ve charges on it due to difference of electro negativity between bonded atoms **is called polar molecules.** For example H8+ – Cl8–

Non–polar molecules:

A molecule in which bonded atoms have zero or negligible electro negativity difference **is called non–polar molecules.**

For example



Important point to remember: All molecules having same atoms(Homoatomic) are non polar

(iii) Induced Dipole:

A molecule in which polarity is created due to other polar molecule is **called induced dipole**.

Instantaneous Dipole:

The temporary dipole (polarity) produced in a non–polar molecule at a certain instant is **called instantaneous dipole.**

(iv) Dipole

A molecule which has two poles i.e. two charges partial +ve and partial –ve **is known as dipole**.e.g H8+ – Cl8–

Q.2 Define intermolecular forces, and the types of intermolecular forces?

Ans. Intermolecular Forces:

The forces of attraction that exist between all kinds of atoms, molecules, when they are sufficiently close to each other **are called** intermolecular forces.

Types of intermolecular forces:

There are four types of intermolecular forces.

(a) Dipole–dipole forces

(b) Ion–dipole forces

(c) Dipole–induced dipole forces (Debye forces)

(d) Instantaneous dipole–induced dipole forces or (London dispersion forces).

(a) Dipole–dipole forces:

The forces of attraction between the positive end of one polar molecule and the negative end of other polar molecule **are known as dipole–dipole forces.**

Example is of HCl.

$H^{\delta+} \rightarrow Cl^{\delta-} \rightarrow H^{\delta+} \rightarrow Cl^{\delta-} \rightarrow H^{\delta+} \rightarrow Cl^{\delta-}$

(b) Ion–Dipole forces:

The forces of attraction in which the negative ends of polar molecules are attracted towards the cation (+ve ion) and positive ends towards anion (– ion) are called ion–dipole forces. Ionic compounds like Mx are normally soluble in polar solvent like water. Water molecules break the crystal lattice and the ions are set free. These positive and negative ions are then surrounded by water molecules. The negative ends of the dipole of the water are attracted towards the cation (M^+) while the positive ends are attracted towards the anion (X^-). The dissolution of most of the ionic compounds in water is due to this reason. The forces of attraction between ions and water molecules **are known as Ion–dipole forces.**

(c) The forces of attraction that exist between already polar molecules and the molecule having induced dipole forces. The forces are **also called Debye forces.**

(d) Instantaneous Dipole–Induced Dipole forces. (**London dispersion forces**).

The momentary forces of attraction that exist between instantaneous dipole and the induced dipole **are called instantaneous dipole–induced dipole forces.**

The momentary force of attraction between instantaneous dipole and the induced dipole **is known as instantaneous–induced dipole forces**.

Q.3 Explain the factors affecting the London forces.

Ans.

The strength of these forces depends upon the following two factors.

1. **Size of electronic cloud:**

   As the size of electronic cloud of atoms or molecules increases, dispersion becomes easier and these forces are more permanent.

   The elements of zero group are monoatomic gases due to their complete outermost shells, they do not form covalent bonds. Their boiling points increase from top to bottom in a group.

2. **Polarizability:**

The quantitative measurement of the extent to which the electronic cloud can be polarized or distortedis called polarizability.

The boiling points of halogens increase from top to bottom i.e. from fluorine to iodine.

3. Number of atoms:

As the number of atoms in non–polar molecule increases polarizability of the molecule increases and London forces become stronger.

The boiling points of saturated hydrocarbons increase as the number of atoms increases.

Q.4 Define and explain hydrogen bonding./ What is the origin of intermolecular forces in water?

Ans. **Hydrogen bonding:**

"The electrostatic force of attraction between electronegative atom and partial positive hydrogen atom is called hydrogen bonding."

Explanation:

Consider water molecules to understand hydrogen bonding oxygen is more electronegative than hydrogen. So water is polar molecule. There will be dipole–dipole forces of attraction between water molecules. The electrostatic force of attraction between electronegative oxygen of one molecule and partial positive hydrogen of other molecule is called hydrogen bonding.

Strength of H–Bonding:

Hydrogen bonding is stronger than simple dipole–dipole forces.

This is due to the following reasons.

1. There are two lone pairs on oxygen atom. Oxygen forms coordinate covalent bond with hydrogen.
2. There is sufficient partial positive charge on hydrogen. Both positively charged hydrogen of water molecules produce strong electric field due to their small size.

Hydrogen bonding in water molecules acts like a bridge between two electronegative oxygen atoms.

Generally, the strength of H–bonding is twenty times less than that of covalent bond.

Q.5 Give the properties of compounds containing hydrogen bonding.

Ans.

1. There are dynamic properties of covalent compounds.
2. Solubility of Hydrogen bonded molecules.
3. Cleansing action.
4. Application of hydrogen bonding in biological compounds.
5. Surface tension.

6. Effect of hydrogen bonding on viscosity.
7. Hydrogen bonding in paints and dyes.
8. Clothing.
9. Food material.
10. Structure of ice.

Q.6 Explain the following with reasons.

(a) In the hydrogen bonded structure of H–F, which is stronger bond, the shorter covalent bond or the longer hydrogen between different molecules?

(b) In a very cold winter fish in garden ponds owe their lives to hydrogen bonding.

(c) Water and ethanol can mix easily and in all proportions.

Ans.

(a) There is sufficient hydrogen bonding in H–F molecules and it gives zig zag structure. Fluorine atom is present at the end while H atoms are entrapped between two strong electronegative atoms. The covalent bond between H and F is stronger because it is produced by the overlapping of orbital's and two electrons have been shared to give sigma bond.
The bond which is shown by the dotted line is the hydrogen bond due to electrostatic forces of attraction so, it is a weaker bond.

(b) When water is frozen at 0oC, then it expands. This is due to the fact that due to H-bonding in ice the
molecules become arranged density of ice is decreased. That's why ice floats on water.

(c) Water (H-OH) and ethanol (C_2H_5OH) have both are polar solvents and having OH groups. So, they
can do the hydrogen bonding extensively. That is they can mix with each other in all proportions.

Q.7 Why H_2S is a gas while H_2O is liquid at room temperature?

Ans:

This is due to high electro negativity of oxygen as compared to sulphur. Water has hydrogen bonding, but H_2S does not have. Due to absence of hydrogen bonding in H_2S at room temperature, it is a gas.

Q.8 Earthen ware vessels keep water cool?

Ans:

Earthen were vessels are porous- water molecules come out from these pores and evaporate. Heat of the atmosphere can not enter into the liquid. So temperature of the liquid in earthenware's remains less.

Q.9 one feels sense of cooling under the fan after bath?

Ans:

When one takes bath and sits in front of a fan, water on the surface of body evaporates with greater rate.The high energy molecules escape from surface of the body and one feels sense of cooling.

Q.10 Why the heat of vapourization of water is greater than that of CH_4?

Ans:

Water is a polar liquid and due to strong hydrogen bonding high energy is required to separate the molecules from each other at its boiling point. CH_4 is a non-polar and has weak London dispersion forces.

Q.11 Define and explain evaporation is a cooling process. Give reason.

Ans. **Evaporation:** The spontaneous change of liquid into its vapours is called evaporation. It continues at all temperature. Evaporation increases with the increase of temperature.

Explanation: The molecules of liquid are not motionless. The energy of the molecules is not equally distributed.The molecules which have low kinetic energy move slowly while others with high kinetic energy move faster. If one of the higher speed molecules reaches the surface, it may escape the attractions of its neighboring molecules and leaves the bulk of the liquid. This spontaneous change of liquid into its vapours is called **evaporation**

Evaporation causes cooling:

The reason is that when high energy molecules leave the liquid and low energy molecules are left

behind, the temperature of the liquid falls and heat moves from the surrounding to the liquid and

the temperature of the surrounding also falls. So evaporation is a cooling process.

Q.12 H-bonding is present in chloroform and acetone-justify it?

Ans:

Chloroform is a polar compound. Acetone is also a polar compound. When chloroform and acetone are mixed with each other, than they create the forces of attractions due to hydrogen bonding.

Q.13 Evaporation of a liquid takes place at all temperatures give reason?

Ans:

Evaporation takes place due to the K.E of the molecules since the K.E of the molecules can not be zero at any temperature therefore evaporation takes place at all temperatures**.**

Q.14 What are the factors that affect the rate of evaporation?

Ans.

1. **Surface Area:**

Evaporation takes place from liquid surface. If area of the surface of liquid increases the rate of evaporation will also increase.

2. **Temperature:**

Temperature also affects rate of evaporation Higher the temperature faster will be the rate of evaporation.

3. **Intermolecular forces**:

Stronger the intermolecular attractive forces slower is the value of evaporation and vice versa.

Q.15 Define and explain the vapour pressure.

Ans. Vapour Pressure:

The pressure exerted by the vapours on the surface of liquid at equilibrium state at a given temperature is called vapour pressure.

Explanation:

Consider a liquid closed in container at a certain temperature. High energy molecules leave the surface of liquid and gather above the surface in the empty space in the form of vapours. These molecules collide with the walls of container as well as with the surface of liquid. In this way they lose some their kinetic energy and there is a chance that these molecules are recaptured by the liquid surface. This process is known as condensation. Both the process i.e. condensation and evaporation continue, till rates of both processes become equal. This state is called dynamic equilibrium, and the pressure exerted by the vapours at this state on the liquid surface at particular temperature is called vapour pressure. Vapour pressure does not depend upon amount or volume of liquid and surface area.

Q.16 What are the factors affecting *vapour* pressure.

Ans.

1. Nature of liquid
2. Strength of intermolecular forces
3. Size of molecules
4. Temperature.

Q.17 Define boiling point.

Ans.

The temperature at which the vapour pressure of liquid becomes equal to the external atmospheric pressure is called boiling point of liquid.

Q.18 Give variation of vapour pressure and boiling point.

Ans.

Vapour pressure is closely related to boiling point. Variation in vapour pressure depends upon the following factors.

1. **Temperature:**

vapour pressure of a liquid increases by increasing temperature. Higher the temperature more will be the vapour pressure and vice versa. Liquids boil at that temperature when their vapour pressures are equal to 760 torr at sea level. By increasing external pressure boiling point can be increased.

2. **Strength of intermolecular forces:**

Stronger the intermolecular forces lower will be vapour pressure and higher will be the boiling point.

Q.19 What is the effect of external pressure on boiling point?

Ans.

A liquid boils when its internal pressure becomes equal to external atmospheric pressure so, by changing external pressure, a liquid can be boiled at any temperature. If external pressure is greater, the liquid needs more heat to equalize the internal pressure to external atmospheric pressure. Similarly if external pressure is lower, liquid needs less amount of heat to equalize its vapour pressure, the external pressure. under 700 torr (at Murree hills) water boils at 98oC.

Q.20 Why boiling point of water is 98^0C at Murree?

Ans:

At high altitudes the atmospheric pressure becomes low therefore B.P of water at Murree is 98^0C**.**

Q.21 Why boiling point of water is 120^0C at 1489 torr why?

Ans:

The normal B.P of H_2O is 100^0C at 760 torr since B.P increases by increasing pressure therefore B.P of H_2O is 120^0C at 1489 torr.

Q.22 Why the boiling points of the hydrides of second period in group IV-A,V-A,VI-A and VII-A are greater than the B.P of hydrides of third period?

Ans:

The elements of second period are more electronegative than the respective element third period. So,the polarities of the bonds with hydrogen are greater than the third period elements.

$H_2O > H_2S$; $NH_3 > PH_3$;HF > HCI; $CH_4 < SiH_4$

Q.23 Define molar heat of vapourization?

Ans:

The amount of heat required to vapourize one mole of liquid at its boiling point is called molar heat of vapourization.

Q.24 What is vacuum distillation? Explain.

Ans. Definition:

The process in which liquid is heated under reduced pressure, to convert it into its vapours at low temperature and then to condense these vapours into liquid is known as vacuum distillation.

Explanation:

In vacuum distillation boiling point of liquid decreases by reducing the pressure. This is done by connecting the distillation apparatus to the vacuum pump. In this way liquids with high boiling points can be boiled at low temperature.

Q.25 Define enthalpy change.

Ans.

If physical or chemical change occurs at constant pressure then it is known as enthalpy change.

Q.26 What are types of enthalpy changes?

Ans.

There are three types of enthalpy changes.

1. **Molar Heat of Fusion (ΔHf):**

The amount of heat absorbed by one mole of a solid to melt it into liquids at its melting point at atmospheric pressure is called molar heat of fusion. It is denoted by Δ Hf.

2. **Molar Heat of vapourization (Δ Hv):**

The amount of heat absorbed by one mole of a liquid to convert it into one mole of vapours at its boiling point at 1 atmospheric pressure is called molar heat of vapourization. It is denoted by Δ Hv.

3. **Molar Heat of sublimation (Δ Hs):**

The amount of heat absorbed by one mole of a solid to convert it directly into one mole of its vapours at particular temperature at 1 atmospheric pressure is called molar heat of sublimation. It is denoted by Δ Hs.

Q.27 What are liquid crystals? Give their types.

Ans.

The molecules which are large somewhat rigid and linear having some of structures of solids showing optical properties and some of the freedom of motion of liquids are called liquid crystals.

Types of liquid crystals:

(a) Smectic liquid crystals.

(b) Nematic liquid crystals.

(c) Cholesteric liquid crystals.

Q.28 What are solids?

Ans.

Solids are those substances which are rigid, hard, have definite shape and definite volume. The atoms, ions, and molecules, that make up a solid are close packed. They are held together by strong cohesive forces.

Q.29 Crystals have their own habits justify it?

Ans:

The shape of a crystal in which it usually grows called habit of a crystal. The shape of the crystal remains same if its conditions remain same. For example When 10%urea is added in NaCl then needle like crystals are formed instead of cubic crystals

Q.30 Justify that solids are rigid?

Ans:

The solids are very rigid. This rigidity is due to the fixed positions of the particles. The presence of strong cohesive forces makes particles unable to change their positions. This rigidity of solids can be changed under stress

Q.31 Give types of solids?

Ans.

There are two types of solids:

(i) Crystalline solids

(ii) Amorphous solids

Crystalline solids:

Those solids in which atoms, ions or molecules are arranged to a definite three dimensional pattern,are called crystalline solids.

Amorphous solids:

Those solids whose constituent atoms, ions or molecules do not possess a regular orderly arrangement are called amorphous solids.The best examples are glass, plaster and rubber, glue, etc.

Q.32 Define the following:

(i) Cleavage planes.

(ii) Anisotropy

(iii) Symmetry

(iv) Habit of a crystal

Ans.

(i) **Cleavage planes:**

whenever the crystalline solids are broken they do so along definite planes. These planes are called the cleavage planes.

(ii) **Anisotropy**:

Some of the crystals show variation in physical properties depending upon the direction; such properties are called anisotrophic properties and the phenomenon is called anisotropy.

(iii) **Symmetry:**

The repetition of faces angles or edges when a crystal is rotated by 360o along its axis is called symmetry.

(v) **Habit of a crystal**:

The shape of a crystal in which it usually grows is called habit of crystal.

Q.32 Define the following:

(i) Isomorphism

(ii) Polymorphism

(iii) Allotropy

(iv) Transition temperature

(v) Crystal lattice

(vi) Unit cell

Ans.

(i) **Isomorphism:**

Isomorphism is the phenomenon in which two different substances exist in the same crystalline form. These different substance are called isomorphs of each other.

Examples of ismorphs are NaNO3, CaCO3,K2SO4, K2CrO4.

(ii) **Polymorphism:**

Polymorphism is a phenomenon in which a substance exists in more than one crystalline forms. The substance which exists in more than one crystalline forms is called polymorphic, and these forms are called polymorphs of each other. Polymorphs have same chemical properties but they differ in the physical propertiesAgNO3, CaCO3 are polymorphs.

(iii) **Allotropy**:

The existence of an element in more than one crystalline form is known as allotropy and these forms of the element are called allotropes or allotropic forms.

Element	Crystalline forms
Carbon	Cubic (Diamond)

Hexagonal (Graphite).

(iv) **Transition Temperature:**

It is that temperature at which two crystalline forms of the same substance can coexist in equilibrium with each other. At this temperature one crystalline form of substance changes to one another.95.50

Sulphur S8 (rhombic) sulphur S8 (monoclinic)

(v) **Crystal lattice:**

A crystal lattice is defined as an array of points representing atoms, ions or molecules of a crystal arranged at different sites in three dimensional space.

(vi) **Unit cell:**

The smallest part of crystal lattice has all the characteristic features of the entire crystal is called unit cell.

The simplest unit cell is a cubic unit cell.

Q.33 Name the crystal systems.

Ans. (Cu T Or T He Mo Tri)

1. Cubic system
2. Tetragonal system
3. Orthorhombic or Rhombic system
4. Monoclinic system
5. Hexagonal system
6. Trigonal system
7. Triclinic system

Q.34 Define lattice energy.

Ans.

The energy released when one mole of the ionic crystal is formed from the gaseous ions.It is also defined as the energy required to break one mole of solid into isolated ions in the gas phase. It is expressed in kJ mol–1.

$$Na^+(g) + Cl^-(g) \rightarrow NaCl(s) \quad \Delta H - 792 \text{ kJ mol}^{-1}$$

or

$$NaCl(3) \rightarrow Na^+(g) + Cl^-(g).$$

Q.35 Describe the types of crystalline solids.

Ans.

There are four types of crystalline solids, depending upon the type of bond present in them.

1. Ionic solids.
2. Covalent solids.
3. Metallic solids.
4. Molecular solids.

1. **Ionic Solids:**

Crystalline solids in which the particles forming the crystals are positively and negatively charged ions are called ionic solids.These ions are held together by strong electrostatic forces of attraction. These attractive forces are also called i**onic bonds**. The crystals of NaCl, KBr etc. are ionic solids.

2. **Covalent solids:**

The crystalline solids in which atoms of similar or different elements are held together by covalent bonds are known as **covalent solids**. They are also called atomic solids.

There are two types of covalent solids.

Type 1:

When covalent bonds give joint molecules like diamond, silicon carbide or Aluminum nitride.

Type 2:

When atoms join to form the covalent bonds and separate layers are produced like that of graphite, cadmium

iodide and boron nitride.

3. **Molecular solids:**

The solid substance in which the particles forming the crystals are polar or non–polar molecules or atoms, are called molecular solids. In solidified noble gases, there are non–polar atoms. Two types of intermolecular forces hold them together.

1. Dipole–dipole interactions
2. Vander Waal's forces

These intermolecular forces are much weaker then the forces of attraction between the cations and the anions in ionic crystals and between the atoms in the covalent crystals. Ice and the sugar are the best example of crystals having polar molecules, whereas iodine sulphur and carbon dioxide form crystals containing non–polar molecules.

4. **Metallic solids:**

The crystalline solids in which the metal atoms are held together by metallic bonds are known as metallic solids.

Metallic Bond:

The force of attraction that binds positive metal ion to the number of electrons with in its sphere of influence is called **metallic bond.**

Theories of metallic bond:

1. Electron gas theory
2. Valence bond theory
3. Molecular orbital theory

Q.36 Iodine dissolves readily in tetrachloromethane. Give reason.

Ans.

We know that "like dissolve like". Iodine is a non–polar substance. So it becomes solvable in non–polar solvent CCl_4.

Q.37 Justify molecular solids are soft and compressible?

Ans:

The forces which hold the molecules together in molecular structure are weak so, they are soft and compressible

Q.38 What is crystallite?

Ans:

The small regions in amorphous solids where particles have a regular arrangement are called crystallites.

Q.39 Why diamond is bad conductor of electricity?

Ans:

In diamond each carbon is SP^3 hybridized there is no free electron to conduct electricity therefore it is bad conductor.

Q.40 Why metals have shiny surface?

Ans:

When light falls on the surface of metals then the electrons are excited after de-exictation they emit energy in the form of light therefore they show shiny surface.

Q.41 Why Na is soft while Cu is hard?

Ans:

In sodium only one mobile electron is present while in copper two mobile electrons are present due to strong metallic bond in copper it is hard.

Q.42 Why ionic crystals are brittle?

Ans:

Because ionic solids are composed of parallel layers which contain cations & anions in alternate positions, so that the opposite ions in the various parallel layers lie over each other. When an external force is applied one layer of the ions slide pass over other layer. In this way due to repulsion of similar ions the crystals show brittleness.

Q.43 Electrical conductivity of metals decreases by increasing temperature?

Ans:

With the increases in temperature the positive ions of metals also vibrate which hinders the motion of mobile electrons due to this hindrance electrical conductivity also decreases.

Q.44 What is coordination no. of an ion? What is the coordination no of the cation in (a)NaCl, and(b)CsCl?

Ans:

The no. of positive ions which surround the anion called coordination no. of anion (a) Coordination no. Na in NaCl is 6 (b) Coordination no of Cs in CsCl is 8 (due to the greater size of Cs)

Chapter- 05 ATOMIC STRUCTURE

SHORT QUESTIONS AND ANSWERS

Q.1 Why it is necessary to decrease the pressure in the discharge tube to get the cathode rays?

Ans.

The current does not flow through the gas at ordinary pressure even at high voltage about 500 volts. However when the pressure inside the tube is decreased, the gas in the tube begins to conduct electricity at low pressure. Therefore it is necessary to decrease the pressure in the discharge tube to get the cathode rays.

Q.2 Which ever gas is used in the discharge tube the nature of the cathode rays remains the same why?

Ans.

A cathode ray consists of beam of electrons and electrons are constituents of all matter so, cathode rays do not depend upon the nature of the gas. Therefore, whichever gas is used in the discharge tube, the nature of cathode rays remains the same.

Q.3 Why e/m value of cathode rays is just equal to that of electrons?

Ans.

A cathode ray consists of beam of electrons, so cathode rays are actually electrons. Therefore e/m value of cathode ray is just equal to that of electron.

Q.4 The bending of the cathode rays in the electric and magnetic field show that they are negatively charged.

Ans.

The cathode ray beam travels in a straight line from the cathode to anode. The beam bends toward the south pole of the magnet when it passes through the magnetic field, which shows the cathode rays are negatively charged.

Q.5 Why positive rays are also called canal rays?

Ans.

Since positive rays produced in the discharge tube passed through the canals or holes of cathode, therefore positive rays are also called canal rays.

Q.6 The e/m values of positive rays for different gases are different but those for cathode rays, the e/m value is the same.

Ans.

The e/m value of positive rays depends upon the nature of gas used in the discharge tube. The characteristic of the gas varies from gas to gas, but for cathode rays e/m value is independent of the nature of the gas. Therefore, e/m values of positive rays for different gases are different but those for cathode rays the e/m value is the same.

Q.7 The e/m value for positive rays obtained from hydrogen gas 1836 times more than that of an electron?

Ans.

The mass of hydrogen gas is 1836 times more than that of an electron. Cathode rays consist of beam of electrons. The e/m value for positive rays depends upon the gas used in the tube, and e/m value for cathode rays is independent of the nature of the gas. Therefore e/m value for positive rays obtained from H_2 gas is 1836 times less than that of cathode rays. Heavier the gas, the smaller the e/m value for positive rays.

Q.8 Justify, that cathode rays are material particles.

Ans.

Cathode rays drive a small paddle, wheel which shows that these rays posses momentum. From this observation, it is inferred that cathode rays are not rays but particles having a definite mass and velocity. Therefore cathode rays are material particles.

Q.9 How neutrons are produced?

Ans.

When a stream of α–particles from a polonium source is directed at beryllium target, penetrating radiations are produced, which are called neutrons.

$He + Be \rightarrow C + n$

Q.10 Why the neutrons are used as projectile?

Ans:

The particles, which hit the nucleus and can change its nature are called projectile. A projectile must be chargeless otherwise it will be captured or repelled by the nucleus. The slow moving neutrons cause nuclear reactions like fission and are used in artificial radioactivity. They are chargeless; therefore they can be used as projectile in nuclear research.

$n + Cu \rightarrow Cu + hv$ (γ- radiations)

$Cu \rightarrow Zn + {}_{-1}e$ (β-particle)

Q.10 How are x–rays produced?

Ans.

X–rays are produced when fast moving electrons collide with heavy metal anode in the discharge tube.

Q.11 why the potential energy of bounded electron is negative in Bohr's model?

Ans.

The potential energy of bounded electron is negative, because the energy of separated nucleus and electron is taken to be zero. As electron is brought from infinity towards the nucleus to form a stable state of the atom, energy is released because of attractive forces and the energy becomes less than zero, or negative. Therefore, the energy of the bounded electron is negative.

Q.12 Why the total energy of bounded electron in negative in Bohr's model?

Ans.

The total energy of bounded electron is negative because the electron is under the force of attraction of the nucleus to have a stable state of the atom. More over when we calculate the total energy of the bounded electron, which is the sum of K.E. and P. E comes which is also negative.

Q.13 Explain that energy of an electron is inversely proportional to n^2, but energy of higher orbits are always greater than those of the lower orbits in Bohr's model.

Ans.

The energy of an electron in the nth orbit is

$E_n = -$

where e, m, 00 and h are all constants, thus $E_n \propto$

The more negative the energy is the more stable will be the atom. The energy becomes successively less negative, therefore the energy values of higher orbits are always greater than those of the lower orbits.

Q.14 Explain the energy difference between adjacent levels goes on decreasing sharply in Bohr's model.

Ans.

The energy difference between adjacent levels goes on decreasing, because the distance between the adjacent orbits increases.

Q.15 why does cathode rays produce shadow of an opaque object placed in their path.

Ans.

Any object which is material in nature, produces its shadow. Since cathode rays are material in nature, therefore, they produce shadow of an opaque object placed in their path.

Q.16 Give the main points of quantum theory of radiation.

Ans.

1. Energy is emitted or absorbed by atoms only in the form of packets called quantum.
2. The amount of energy associated with a quantum of radiation is proportional to the frequency (υ) of the radiation.

   $E \propto \upsilon$

   or $E = h\upsilon$
3. A body can emit or absorb energy only in terms of integral multiples of quantum.

   $E = nh\upsilon$ (where n = 1, 2, 3, 4, 5, ……..)

Q.17 Define frequency, wavelength and wave number.

Ans. Frequency (υ):

The number of waves passing through a point per second is called frequency (υ). Its units are cycles s^{-1}.

Wavelength (λ):

The distance between two successive crests or troughs is called wavelength "λ" and is expressed in Ao or nm.

Wave number:

The number of waves per unit length is called wave number and is reciprocal of wave length.

=

The wave number is expressed (m^{-1}) or per meter.

Q.18 What is spectrum? Differentiate between continuous spectrum and line spectrum.

Ans.

The dispersion of the components of white light, when it is passed through prism is called spectrum. The distribution among various wavelengths of the radiant energy emitted or absorbed by an object is also called spectrum.

Continuous spectrum:

A spectrum containing light of all wavelengths is called continuous spectrum.

In this type of spectrum, the boundary line between the colours cannot be marked. The colours diffuse into each other. One colour merges into another without any dark space. The best example of continuous spectrum is rainbow.

Line spectrum:

When an element or its compound is volatilized on a flame and the light emitted is seen through, a spectrometer. We see distinct lines separated by dark spaces. This type of spectrum is called line spectrum. This is the characteristic of an atom.

Q.19 Describe briefly Rutherford's atomic model.

Ans.

According to Rutherford's model most of the mass of the atom (99.95%) is concentrated in a positively charged centre, called nucleus around which the negatively charged electrons move.

Q.20 On which experiment Rutherford's atomic model is based on, describe it briefly?

Ans.

Rutherford's atomic model is based on the scattering of α–particles emitted from radioactive substances pass through the metal atoms of the foil undeflected by the light weight electrons. When an α–particle does happen to hit a metal–atom nucleus. However, it is scattered at a wide angle because it is repelled by the massive positively charged nucleus.

Q.21 Define orbit and orbital.

Ans. Orbit:

A definite circular path at a definite distance from the nucleus in which the electrons revolve around the nucleus is called an orbit.

K, L, M, N are orbits.

Orbital:

A three dimensional region or space around the nucleus, within which the probability of finding an electron is maximum called an orbital, s, p, d and f are atomic orbitals.

Q.22 What do you understand by wave particle duality and what is the de Broglei relation?

Ans.

According to de Broglei, all matter particles in motion have a dual character. It means that electrons, protons, neutrons, atoms, and molecules, possess the characteristics of both the material particle and a wave. This is called wave particle duality in matter.

De Broglei derived a mathematical equation which relates the wavelength (λ) of the electron to the momentum of electron (mv)

$\lambda =$

Where λ = wavelength v = velocity of electron

M = mass of electron and h is Planck's constant.

This equation $\lambda =$ is called de Broglie relation.

Q.23 What is Heisenberg's uncertainty principles?

Ans.

Heisenberg showed that it is impossible to determine simultaneously both the position and momentum of an electron. Suppose that Δx is the uncertainty in the measurement of the position and Δp is the uncertainty in the measurement of momentum of an electron.

$\Delta x \cdot \Delta p \geq$

This relationship is called uncertainty principle.

Q.24 What are quantum numbers?

Ans.

The dimensionless numbers, rise naturally when the Schrodinger wave equation is solved for electron wave patterns and their energies are called quantum numbers.

These numbers describe the behaviour of electron in an atom completely.

There are four quantum numbers.

1. Principal quantum number "n"

It describes the energy of an electron in an atom. The value of n represents the shell or energy level in which the electron revolves around the nucleus. These shells are named as K, L, M, N, O, P, having the values of n, 1, 2, 3, 4, 5 and 6 respectively. The greater the value of n, the greater will be the distance from the nucleus and greater will be the energy of electron in the shell.

2. Azimuthal quantum number "*l*"

It determines the shape of orbital, it can have any integer value from 0 to n–l. this quantum number is used to represent the sub–shells, and these value are l = 0, 1, 2, 3. These values represent different sub–shells which are designated as s, p, d, and f, with values of l = 0, 1, 2, 3 respectively.

3. Magnetic quantum number (m)

It describes the orientation of the orbital in space. It can have all the integral values between $+l$ and $-l$ through zero i.e. $+l$ …….. 0 …….. $-l$. For each value of l, there will be $(2l + 1)$ values of m. actually the values of m gives us the information of degeneracy of orbitals in space.

4. Spin quantum number (s)

It describes the spin of electron in atom. Since an electron can spin clockwise or anti clockwise, thus two possible values are + and – depending upon the spin of electron.

Q.25 What is $n + l$ rule?

Ans.

This rule says that sub–shells are arranged in the increasing order of (n + l) values and if any two sub–shells have the same (n + l) values, then the sub–shell is filled first whose n values is smaller.

Q.26 What is the origin of line spectrum?

Ans.

According to Bohr's theory each bright line in a line spectrum results from the downward jump of electron from a higher energy E2 to lower energy E1. This difference in energy (E2 – E1) is emitted as radiation of definite frequency in the form of spectral line.

According to the quantum theory of radiation,

$E1 - E2 = h\upsilon$

Or $\upsilon =$

Q.27 When is Zeeman effect?

Ans.

When the excited atoms of hydrogen are placed in a magnetic field, its spectral line are further split up in to closely spaced lines. This type of splitting of spectral lines is called Zeeman effect.

Q.28 What is stark effect?

Ans.

When the excited hydrogen atom are placed in an electric field, its spectral lines are further split up into closely spaced lines. This type of splitting of spectral lines is called stark effect.

Q.29 What is Mosely's Law?

Ans.

Mosely's law states that the frequency of spectral line in x–ray spectrum varies as the square of atomic number of an element emitting it. This law convinces us that it is the atomic number and not the atomic mass of the element which determines its characteristic properties, both physical and chemical.

Q.30 Describe Summerfield's modification of Bohr's model atom.

Ans.

Summerfield suggested that the moving electron revolves in elliptical orbits in addition to circular orbit, with the nucleus situated at one of the foci of the ellipse. The elliptical paths of the

moving electron go on changing their position in space, and the nucleus is buried by the electronic cloud from all the sides.

Q.31 Which of these orbitals, 3d or 4s has higher energy level?

Ans.

For 3d, $n + l = 3 + 2 = 5$ and for 4s, $n + l = 4 + 0 = 4$. Therefore 3d orbital has higher energy, than 4s orbital.

Q.32 How many maximum number of electron can have an orbital and a shell?

Ans.

An orbital can have maximum two electrons with opposite spins. A shell can have maximum of $2n^2$ electrons, where "n" is the principal quantum number. First shell can have maximum 2 electrons, 2nd shell have 8 electrons 3rd shell have 18 electrons etc.

Q.33 Distribute electrons in orbitals of 19K, 29Cu, 24Cr, 53I.

Ans.

19K $\rightarrow$ $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$

29Cu $\rightarrow$ $1s^2, 2s^2, 2p^6, 3s^2\ 3p^6, 3d^{10}, 4s^1$

24Cr $\rightarrow$ $1s^2, 2s^2, 2p^6, 3s^2\ 3p^6, 3d^5, 4s^1$

53I $\rightarrow$ $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 5s^2, 5p^5$

Q.34 What does it mean, when we say energy is quantized?

Ans.

Quantization means that energy can only be absorbed or emitted in specific amounts or multiples of these amounts. This minimum amount of energy is equal to a constant times the frequency of the radiation absorbed or emitted $E = hv$.

Q.35 Why do not we notice the quantization of energy in every day activities?

Ans.

In everyday activities, macroscopic objects such as our bodies gain or lose total amounts of energy much larger than a single quantum, hv. The gain or loss of the relatively minuscule quantum of energy in unnoticed.

Q.36 Explain the existence of line spectra is consistent with Bohr's theory of quantized energies for the electron in the hydrogen atom.

Ans.

When applied to atoms, the notion of quantized energies means that only certain values of ΔE are allowed. These are represented by the lines in the emission spectra of excited atoms.

Q.37 In what ways does de Broglie's hypothesis require revision of our picture of the H–atom based on Bohr's model?

Ans.

De Broglie's hypothesis not electrons have a characteristic wavelength requires, revision of Bohr's particle only model. For example the idea of a fixed orbit for the electron in hydrogen is hard, to reconcile with the wave properties of electron.

Q.38 (a) For $n = 4$ what are possible values of l?

(b) For $l = 2$ what are the possible values of m.

Ans.

(a) $n = 4 \quad l = 3, 2, 1, 0$

(b) $l = 2 \quad m = -2, -1, 0, 1, 2$

Q.39 Which of the following are permissible sets of quantum numbers for an electron in a hydrogen atom?

(a) $n = 2 \quad l = 1 \quad m = 1$
(b) $n = 1 \quad l = 0 \quad m = -1$
(c) $n = 4 \quad l = 2 \quad m = -2$
(d) $n = 3 \quad l = 3 \quad m = 0$

Ans.

(a) permissible 2p (b) not permissible
(c) Permissible 4d (d) not permissible

Q.40 (a) What are the possible values of the electron spin quantum numbers?

(b) What piece of experimental equipment can be used to distinguish electrons that have different values of the electron spin quantum number?

(c) Two electrons in an atom both occupy the Is orbital. What quantity must be different for the two electrons? What principle governs the answer to this question?

Ans.

(a) $+ , -$
(b) A magnet with a strong inhomogeneous magnetic field.
(c) They must have different spin quantum number values. The Pauli exclusion principle.

Q.41 Give region of different spectral lines.

Ans.

1. Lyman series (U. V. region)
2. Balmer series (visible region)
3. Paschen series (I. R. region)
4. Bracket series (I. R. region)
5. Pfund series (I. R. region)