ISC Class 12 Exam 2024

Chemistry

Short Answer Type Questions

1. What is a colligative property ? Give two examples.

Ans. The properties of dilute solutions which depend upon the number of solute particles (molecules or ions) but not upon their nature are called colligative properties. Relative lowering of vapour pressure and elevation in boiling point are the two example of colligative property.

2. Name two ways of measuring the concentration of a solution which are not dependent on temperature.

Ans. Molality and mole fraction are the two methods to measure the concentration which are not dependent on temperature.

3. Define Raoult's law for the elevation of boiling point of a solution.

Ans. According to Raoults' law, elevation of boiling point of a solution is directly proportional to the lowering in vapour pressure caused by the number of particles of solute present in the solution.

4. What are ideal solutions ? Give two examples.

Ans. An ideal solution is that solution in which each component obeys Raoults law under all conditions of temperature and concentrations.

Examples : Benzene and Toluene, Carbon tetrachloride and Silicon tetrachloride.

5. The elevation of boiling point produced by dilute equimolal solutions of three substances are in the order A > glucose > B. Suggest a reason for this observation.

Ans. This observation suggests that substance A dissociates while substance B associates in the solution because elevation in boiling point depends upon number of particles of the solute present in the solution.

6. Two liquids A and B forms type II non-ideal solution which shows a minimum in its temperature-mole fraction plot (T-c diagram). Can the two liquids be completely separated by fractional distillation ?

Ans. Two liquids A and B forms type II non-ideal solution which shows a minimum in its temperature-mole fraction plot cannot be completely separated by fractional distillation. Upon fractional distillation either A or B is obtained pure along with composite composition.

7. Write down the expression relating elevation of boiling point of a solvent, when a solute is dissolved in it to form a dilute solution and the concentration of the solution, defining the terms.

Ans. If non-volatile solute is added to the pure solvent, its boiling point is elevated. If the boiling point of the solvents is T kelvin and boiling point of the solution as T_{sol}, the elevation of boiling point DT_b will be

$DT_b = T_{sol} - T$

The elevation of boiling point DT_b is related to the concentration of the solution by :

$DT_b = K_b m$

where, K_b = Molal elevation constant

m = Molality of the solution.

8. What is an azeotropic mixture ?

Ans. Azeotropic mixture is a mixture of two liquids having a definite composition, which boils at a constant temperature like a pure liquid. For example 95·57% of ethanol and 4·43% of water forms an azeotropic mixture which boils at 351·15 K.

9. What is an antifreeze ?

Ans. A substance such as ethylene glycol which is added to water to lower its freezing point is called an antifreeze. It delays freezing,

therefore, it is called as on antifreeze.

10. What is reverse osmosis ?

Ans. On applying pressure (higher than osmotic pressure) over solution, solvent particles moves from solution towards solvent through semi-permeable membrane and is named as reverse osmosis.

11. What is a semi-permeable membrane ? Give examples.

Ans. A semi-permeable membrane is a membrane which allows solvent molecules to pass through it but does not allows the solute particles to pass through it.

For example : cell membrane, parchment paper, cellophane, etc.

12. Give three applications of Henry's law.

Ans. Applications of Henry's law :

(i) To increase the solubility of CO2 in soda water and soft drinks, the bottle is sealed under high pressure.

(ii) To avoid the toxic effect of high concentration of nitrogen in the blood, the tanks used by scuba divers are filled with air diluted with helium (11·7% helium, 56·2% nitrogen and 32·1% oxygen).

(iii) At high altitude, low blood oxygen causes climbers to become weak and make them unable to think clearly, which are symptoms of condition known as anoxia.

13. What is standard hydrogen electrode ?

Ans. Standard hydrogen electrode is a reference electrode against which the electrode potentials of all electrodes are measured. When hydrogen gas at 1 atm-pressure is adsorbed over platinum electrode dipped in 1 M HCl at 25ºC, it is standard hydrogen electrode and its potential is $E^º = 0$ volt.

14. What is standard electrode potential ?

Ans. The standard electrode potential is the measure of potential of a reaction that occurs at the electrode when all the substances involved in the reaction are in their standard states that is solutions are at 1M concentrations, gases at 1 atm pressure and solids and liquids are in pure form with all at 25°C.

15. Mention any two factors affecting the electrode potential of a metal.

Ans. Factors affecting the electrode potential of a metal.

(i) Nature of metal : Extremely active metals have low electrode potential, while less active have high electrode potential.

(ii) Temperature : The change in the temperature of the solution also changes the electrode potential.

16. What is an electrochemical series? How is it useful in predicting whether a metal can liberate hydrogen from acid or not ?

Ans. Electrochemical Series : Different metal or metal ion combinations have different values of standard electrode potentials and thus they can be arranged in order of increasing or decreasing values of their standard reduction potentials.

The arrangement of various elements in the order of increasing values of standard reduction potentials is called electrochemical series. The most reactive elements are kept at the top and the less reactive at the bottom.

With the help of the electrochemical series, we can predict whether a given metal can liberate hydrogen from acid or not. The metals which lie above hydrogen in the electrochemical series i.e. having negative standard reduction potential values can liberate hydrogen from dilute acids whereas metals which lie below hydrogen in the electrochemical series i.e., have positive standard reduction potential values cannot liberate hydrogen from dilute acids.

17. Define equivalent conductance. In what units is it expressed ?

Ans. It is defined as the conductance of a solution containing 1 gram equivalent of electrolyte and the solution contained in between two electrodes are 1 cm apart. It’s unit is expressed as ohm – 1 cm2 eq–1.

18. When 96500 coulomb of electricity is passed through a solution of $CuSO_4$, 3·18 g of Cu is deposited on cathode. Name the law and principle to which this observation confirms.

Ans. This observation confirms the Faraday's first law of electrolysis which states that when the same quantity of electricity is passed through several electrolytes, the mass of the substance deposited is proportional to their respective chemical equivalent or equivalent weight.

19. List out three factors which affects the electrolytic conductivity.

Ans. The three factors are :

(i) The inter-ionic attraction (depends on solute - solute interaction)

(ii) The solvation of ions (depends on solute - solvent interaction)

(iii) The viscosity of the solvent (depends on solvent-solvent interaction)

20. Define the corrosion of metals. What is rust ?

Ans. The slow and spontaneous process of the conversion of a metal into an undesirable compound (usually oxide) on exposure to atmospheric conditions is called corrosion of metals. Chemically rust is hydrated iron(III) oxide, $Fe_2O_3.xH_2O$. It is generally caused by moisture, CO_2, O_2 of air. Rust is a non-sticking brown-coloured material which can be easily removed by scratching.

21. Define the order of reaction.

Ans. Order of reaction is the sum of the exponents of the molar concentration of the reactants in the rate equation for a general reaction xA + yB → Product If the rate law is, Rate = k [A] x [B] y then, Order = x+y

22. Name the three factors that usually modify the rate of a reaction.

Ans.

(i) Increase in the concentration of reactants.

(ii) Increase in the temperature.

(iii) Use of catalysts.

23. Give the units of a zero-order rate constant and also give two examples of zero order reaction.

Ans. The unit of zero order rate constant is mol L^{-1} sec^{-1}.

Two examples of zero order reaction :

(i) Photochemical reaction of H_2 and $C1_2$ over water surface.

(ii) Bromination of acetone.

24. A reaction between A and B is of second order. Write three different rate law expressions which might possible apply to the reaction.

Ans.

(i) Rate = k[A] [B]

(ii) Rate = k[A]2

(iii) Rate = k[B]2

25. Write the mathematical expression relating the variation of rate constant of a reaction with temperature.

Ans. Mathematical expression for Arrhenius equation :

$k = Ae^{-Ea/RT}$

Where, k is rate constant of the given reaction.

A is another constant called frequency factor or Arrhenius Constant

E_a is activation energy.

R is gas constant and T is temperature in Kelvin.

26. Define molecularity of a reaction. Give one difference between the order of a reaction and its molecularity.

Ans. The minimum number of reacting particles (molecules, atoms, ions) that comes together or collide in the rate determining step, is called molecularity of the reaction.

Molecularity is always a whole number while order of reaction can be zero, whole number or even fractional.

27. Define threshold energy of a reaction.

Ans. Threshold energy is the minimum energy which must be possessed by reacting molecules in order to undergo effective collisions which leads to formation of product molecules.

28. If at a given temperature a catalyst is added to the reactants, what will happen to the nature of the equilibrium constant ?

Ans. Equilibrium constant will remain unchanged, as the catalyst only accelerates or retards the approach of equilibrium, with the same ratio of the velocities of forward and backward reaction.

29. What is an effective or fruitful collision ?

Ans. A collision in which colliding molecules possess energy equal to or more than threshold energy and the collision has proper orientation of molecules is called an effective collision. It leads to the formation of products.

30. What is the electronic configuration of chromium atom (Z = 24) ? Give a reason for your answer.

Ans. The electronic configuration of Cr atom is :

$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^1$

This is because an electronic configuration with half-filled and completely filled orbitals is more stable. $_{24}Cr$ has 3d orbitals half-filled which is more stable configuration than normally expected i.e., $3d^4\ 4s^2$.

31. On what gound can you say that Sc (Z = 21) is a transition element while Zn (Z = 30) is not ?

Ans. The outer electronic configuration of scandium (Z = 21) is $3d^{14}s^2$ while that of zinc(Z = 30) is $3d^{10}4s^2$. Since scandium has incompletely filled d-orbital in its ground state it is regarded as transition metal while zinc do not have incompletely filled d-orbital in either ground state or any of its oxidised state so it is not regarded as transition metal.

32. Which metal in the first series of transition metals exhibit + 1 oxidation state most frequently and why ?

Ans. In the first series of transition metals, copper metal (with electronic configuration $[Ar]3d^{10}\ 4s^1$) exhibits + 1 oxidation state most frequently as it readily loses one electron (present in 4s orbital) to give stable $3d^{10}$ electronic configuration.

33. Give first and last atomic number of all the three transition series.

Ans. First and last atomic number of all the three transition series :-

(a) First transition series: This series contains elements from atomic number 21 (scandium) to atomic number 30 (Zinc).

(b) Second transition series: This series contains elements from atomic number 39 (Yttrium) to atomic number 48 (cadmium)

(c) Third transition series: This series contains elements 57 (Lanthanum) and from atomic number 72 (Hafnium) to atomic number 80 (Mercury).

34. In what way is the electronic configuration of the transition elements different from that of the non-transition elements ?

Ans. Transition metals have a partially filled d-orbital. Therefore, the electronic configuration of transition elements is $(n-1)d^{1-10}ns^{0-2}$. The non-transition elements either do not have a d-orbital or have a fully filled d-orbital. Therefore, the electronic configuration of non- transition elements is ns^{1-2} or $ns^2\ np^{1-6}$.

35. What are inner transition elements ? Describe which of the following atomic numbers are the atomic numbers of the inner transition elements: 29, 59, 74, 95, 102, 104.

Ans. Inner transition metals are those elements in which the last electron enters the f-orbital.The elements in which the 4f and the 5f orbitals are progressively filled are called f-block elements.

(i) Lanthanoids (4f-series). These are the 14 elements from atomic numbers 58 - 71.

(ii) Actinoids (5f-series). These are the 14 elements from atomic numbers 90 - 103.

Among the given atomic numbers, only 59, 95 and 102 are the atomic numbers of inner transition elements.

36. What are alloys ? Name an important alloy which contains some of the lanthanoid metals. Mention its uses.

Ans. An alloy is a homogeneous mixture of a metal with other metals or non-metals. A large number of alloys of transition metals are known and extensively used in modern industries. An important alloy which contains some of lanthanoid metals is 'misch-metal'.

Uses of Misch-metal :

(i) Addition of about 3% misch metal to magnesium increases its strength and thus is used in making jet engine parts.

(ii) It is pyrophoric and is used in cigarette and gas lighters, tracer bullets, shells, etc.

37. State the common oxidation state of : (i) Lanthanides (ii) Actinides

Ans. (i) Oxidation state of lanthanides is + 3. Some lanthanides show + 2, + 4 as well.

(ii) Oxidation state of actinides is + 3 but many actinides also show + 2, + 4 and some + 5, + 6, +7 also.

38. What is Lanthanoid contraction ? Discuss its causes.

Ans. As the atomic number increases in lanthanoid series, for every proton in the nucleus the extra electron goes to fill 4f-orbitals. The 4f-electrons constitute inner shells and are rather ineffetive in screening the nuclear charge. Thus, there is a gradual increase in the effective nuclear charge experienced by the outer electrons. Consequently, the attraction of the nucleus for the electrons in the outermost shell increases as the atomic number of lanthanoids increases and the electron cloud shrinks. This results in gradual decrease in size of lanthanoids with increase in atomic number.

39. What are the different oxidation states exhibited by the lanthanoids ?

Ans. The principal oxidation state of lanthanoids is + 3. However, some lanthanoids also exhibit oxidation states of +2 and + 4. For example, Eu exhibit oxidation state of + 2 and Ce exhibits oxidation state of + 4.

40. What is tailing of mercury ?

Ans. Due to the dissolution of Hg2O in mercury, the mercury loses its meniscus and starts sticking to the sides of the glass. This is called as the tailing of mercury.

41. In a coordination complex, from where does the electron pair donation takes place ?

Ans. In a coordination complex, donation of electron pair takes place from the ligand to the central metal atom.

42. For the complex ion, [Fe(CN)6]3-state :

(i) The geometry of the ion.

(ii) The magnetic property of the ion.

Ans. (i) Octahedral geometry (ii) Ion is paramagnetic.

43. Define coordination compounds.

Ans. The compounds in which ions or neutral molecules are bonded to a central metal atom by coordinate bonds are called coordination compounds e.g., [Ni(CO)4], [COCl3(NH3)3] etc. They are also called complex compounds.

44. Define multidentate ligands.

Ans. A ligand that forms a coordinate bond by donating two or more pairs of electrons in a complex reaction are called as multi-dentate ligands.

45. What are donor sites ?

Ans. A donor atom may contain one or more upshared pair of electrons which are known as donor sites of the ligand.

46. Name the types of isomerism shown by the following pairs of compounds :

(i) $[Cu(NH_3)_4][Pt(C1_4)]$ and $[Pt(NH_3)_4][CuC1_4]$

(ii) $[Co(Pn)_2C1_2]$ and $[Co(tn)_2C1_2]^+$

Ans. (i) Co-ordination isomerism (ii) Ligand isomerism

47. Define oxidation number.

Ans. It is the residual charge that appears on the central atom when all other atoms or ions are removed from it.

48. What are alkyl halides? What is their general formula ?

Ans. Halogen drivatives of alkanes are called alkyl halides. A general formula of monohaloalkanes is $C_nH_{2n} + _1 X$.

49. Discuss the ability of alkyl halides to dissolve :

(i) in H_2O, (ii) in organic solvents.

Ans. (i) They are insoluble in H_2O, probably because there is little (in case of alkyl halides to no H-bonding with H_2O.

(ii) They are soluble in organic solvents such as alcohol, ether and benzene.

50. List the densities of chloromethane, fluoromethane, iodomethane, bromomethane, water and methane in decreasing order.

Ans. The decreasing order is $CH_3I > CH_3Br > H_2O > CH_3C1 > CH_3F > CH_4$.

51. Arrange the following halides in order of increasing SN2 reactivity :

CH_3C1, CH_3Br, CH_3CH_2C1, $(CH_3)_2$ CHC1

Ans. As the size of R group increases, the reactivity towards S_N^2 reaction decreases. Further, C-Br bond is weaker than C-C1 bond and it is difficult to cleave C-C1 bond.

$(CH_3)_2CHC1 < CH_3CH_2C1 < CH_3C1 < CH_3Br$

52. What is a cannizzaro reaction ? Is cannizzaro reaction given by all the aldehydes ?

Ans. A chemical reaction that involves the base induced disproportionation of an aldehyde lacking a hydrogen atom in the alpha position is called cannizzaro reaction.

$2C_6H_5CHO + NaOH \rightarrow C_6H_5COONa + C_6H_5CH_2OH$

No, only by those aldehydes which do not have a hydrogen atom.

53. What are the monosaccharides ? Name the functional group common to both glucose and fructose.

Ans. Monosaccharides, also called simple sugars, that cannot be broken down by hydrolysis into other simpler sugars. Alcoholic group is common to both glucose and fructose.

54. Classify the following into monosaccharides and disaccharides. Ribose, 2-deoxyribose, maltose, galactose, fructose and lactose.

Ans. Ribose, 2-deoxyribose, galactose and fructose are monosaccharides. Maltose and lactous are disaccharides.

55. What do you understand by the term glycosidic linkage ?

Ans. In oligosaccharides and polysaccharides, the two monosaccharide units are linked together by an oxide or other linkage formed by the loss of a water molecule. Such a linkage between two monosaccharide units through oxygen atom is called glycosidic linkage.

56. Give one example of a fibrous protein. Name the final product of hydrolysis of proteins. What is denaturation of proteins ?

Ans. Myosin in muscles is a fibrous protein. Amino acid is obtained as the final product of hydrolysis of proteins. Denaturation of proteins: When proteins are heated or subjected to the action of alkalis etc. their physical and biological properties changes drastically without change in their chemical nature. This process is called as denaturation of proteins.

57. Explain the following terms :

(i) Native protein

(ii) Denaturation

(iii) Renaturation

(iv) Mutarotation

(v) Isoelectric point

Ans. (i) Native protein: It is the protein found in a biological system with definite configuration and biological activity.

(ii) Denaturation: When a protein is subjected to some physical or chemical treatment which disrupts its higher structure without affecting its primary structure, the process is called denaturation. The denatured protein loses its biological activity. For example, boiling of an egg. The denaturation may be reversible or irreversible.

(iii) Renaturation: In many cases a denatured protein recovers its physical and chemical properties and biological activity when the disruptive agent is removed. This process, which is reverse of denaturation, is known as

renaturation.

(iv) Mutarotation:The spontaneous change of specific rotation of an optically active substance with time is called mutarotation.

(v) Isoelectric point: It is the pH at the net charge of a protein molecule is zero.

58. What type of bonding occurs in globular proteins ?

Ans. Globular proteins have :

(i) Cross-linked bonding

(ii) Weak intermolecular hydrogen bonding.