

# **MOST EXPECTED QUESTIONS**

## **PHYSICAL CHEMISTRY**

# **CBSE 2021**



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**Solid States**

**Solutions**

**Chemical Kinetics**

**Electrochemistry**

**Surface  
Chemistry**

## **UNIT: 1:-SOLID STATE**

1. Why are solids rigid?
2. Why do solids have a definite volume?
3. Define the term 'amorphous'. Give a few examples of amorphous solids.
4. Write three main differences between Amorphous and Crystalline Solids.
5. Crystalline solids are anisotropic in nature. What does this statement mean.
6. Why is glass considered a super cooled liquid.
7. Refractive index of a solid is observed to have the same value along all directions. Comment on the nature of this solid. Would it show cleavage property?
8. Classify the following as amorphous or crystalline solids: (i) Polyurethane, (ii) naphthalene, (iii) benzoic acid, (iv) Teflon, (v) potassium nitrate, (vi) cellophane, (vii) polyvinyl chloride, (viii) fibre (ix) glass, (x) copper.
9. In a tabular form Classify the solids on the basis of different binding forces also mention Nature of binding force, physical nature & electrical conductivity
10. Why is glass of window panes of very old buildings found to be thicker at the bottom than at the top.
11. Some of the very old glass objects appear slightly milky instead of being transparent. why?
12. In a tabular form Classify the solids on the basis of different binding forces also mention Nature of binding force, physical nature & electrical conductivity
13. Classify each of the following solids as ionic, metallic, molecular, network (covalent) or amorphous. (a) Tetra phosphorus decoxide ( $P_4O_{10}$ ) (b) Graphite (c) Ammonium phosphate ( $(NH_4)_3PO_4$ ) (d) Brass (e) SiC (f) Rb (g)  $I_2$  (h) LiBr (i)  $P_4$  (j) Si (k) Plastic
14. Classify the following solids in different categories based on the nature of intermolecular forces operating in them: (a) Potassium sulphate, (b) tin, (c) benzene, (d) urea, (e) ammonia, (f) water, (g) zinc sulphide, (i) graphite, (j) rubidium, (k) argon, (l) silicon carbide.
15. Based on intermolecular forces classify following : Potassium sulphate Tin Benzene Urea Ammonia  $H_2O$  zinc sulphide Graphite Rubidium Argon Silicon carbide Silver Sodium Sulphate Hydrogen  $I_2$   $CO_2$   $SO_2$
16. What type of solids are electrical conductors, malleable & ductile.
17. What type of interactions hold the molecules together in a polar molecular solid.
18. Write a distinguishing feature of metallic solids.
19. What makes a glass different from a solid such as quartz? Under what conditions could quartz be converted into glass?
20. How do metallic and ionic substances differ in conducting electricity?
21. Ionic solids conduct electricity in molten state but not in solid state. Explain.
22. What type of solids are electrical conductors, malleable and ductile?
23. Solid A is a very hard electrical insulator in solid as well as in molten state and melts at extremely high temperature. What type of solid is it?
24. Copper is conducting such while copper sulphate is conducting only in molten state or in aqueous solution. why
25. Explain the basis of similarities and differences between metallic and ionic crystals.
26. Why Ionic solids are hard and brittle.

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27. What is Unit cell? Name the parameters that characterize unit cell.
28. Give the significance of Lattice point. Write difference between : Crystal lattice and unit cell
29. Distinguish between (i) Hexagonal and monoclinic unit cells (ii) Face-centred and end-centred unit cells.
30. How much portion of an atom located at (i) corner and (ii) body centre (iii) faces of a cubic unit cell is part of its neighbouring unit cell .
31. Calculate the Number of atoms per unit cell in Simple cubic; Body centred Cubic (bcc), Face-centred cubic (fcc).
32. How many lattice points are there in one unit cell of each of the following lattice? (i) Face-centred cubic (ii) Face-centred tetragonal (iii) Body-centred
33. A cubic solid is made of two elements P and Q. Atoms of Q are at the corners of the cube and P at the body-centre. What is the formula of the compound? What are the coordination numbers of P and Q?
34. A cubic solid is made of two elements A and B. Atoms of A are at the corners of the cube and B at the Face-centre. What is the formula of the compound?
35. An ionic compound made up of atoms A & B has a face centred cubic arrangement in which atoms are at the corners and B atoms are at face centres. If one of the atoms is missing from the corner, what is the simplest formula of the compound.
36. In a face centred cubic lattice, atom A occupies the corner positions and atom B occupies the face centre positions. If one atom of B is missing from one of the face centred points. What is the formula of the compound?
37. A cubic solid is made of two elements X and Y. Atoms of A are at the corners of the cube and B at the centre of alternate Faces. What is the formula of the compound?
38. A compound made up of elements A and B crystallizes in the cubic structure. Atoms a are present on the corners as well as face centres whereas atoms B are present on the edge centres as well as body centre. What is the formula of the compound?
39. If three elements P, Q, & R crystallizes in the cubic structure with P atoms at the corners, Q atoms at the cube centre and R atoms at the centre of the faces of the cube What is the formula of the compound?
40. A solid has a cubic structure in which X atoms are located at the corners of the cube, Y atoms are at the cube centres and O atoms are at the edge centres. What is the formula of the compound?
41. In an alloy of gold and cadmium, gold crystallizes in cubic structure occupying the corners only and cadmium fits into the face centre voids. What is quantitative composition of the alloy ?
42. Calculate the number of unit cells in 8.1 g of aluminum if it crystallizes in f.c.c structure. (Atomic mass of Al=27gm/mol). **[Ans:  $4.515 \times 10^{22}$ ]**
43. Calculate the number of unit cells in 9.2 g of sodium if it crystallizes in b.c.c structure. (Atomic mass of Na=23 gm/mol). **[Ans:  $1.204 \times 10^{23}$ ]**
44. Potassium crystallizes in a body centered cubic lattice. What is the approximate number of unit cells in 4.0g of potassium? Atomic mass of potassium = 39. **[Ans:  $3.09 \times 10^{22}$ ]**
45. Derive the relationship between edge length (a) of unit cell and radius of atom (r) for (i) simple cubic (ii) body –centered cubic (iii) face –centered cubic (with the assumptions that atoms are touching each other) or hcp or ccp

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46. Silver crystallizes in fcc lattice. Each side of the unit cell has a length of 409 pm. What is the radius of an atom of silver.
47. Aluminium crystallises in a cubic close-packed structure. Its metallic radius is 125 pm. (i) What is the length of the side of the unit cell? (ii) How many unit cells are there in  $1.00 \text{ cm}^3$  of aluminium?
48. Gold (atomic radius = 0.144 nm) crystallises in a face-centred unit cell. What is the length of a side of the cell?
49. Calculate the efficiency of packing in case of a metal crystal for (i) simple cubic (ii) body-centred cubic (iii) face-centred cubic (with the assumptions that atoms are touching each other) or hcp or ccp Structures.
50. Calculate the packing fraction for the Ca unit cell, given that Ca crystallizes in a face-centred cubic unit cell.
51. How can you determine the atomic mass of an unknown metal if you know its density and the dimension of its unit cell? Explain.
52. Silver crystallizes in fcc lattice. If edge length of the cell is  $4.07 \times 10^{-8} \text{ cm}$  and density is  $10.5 \text{ g cm}^{-3}$ , calculate the atomic mass of silver.
53. Niobium crystallises in body-centred cubic structure. If density is  $8.55 \text{ g cm}^{-3}$ , calculate atomic radius of niobium using its atomic mass 93 u.
54. X-ray diffraction studies show that copper crystallises in an fcc unit cell with cell edge of  $3.608 \times 10^{-8} \text{ cm}$ . In a separate experiment, copper is determined to have a density of  $8.92 \text{ g/cm}^3$ , calculate the atomic mass of copper.
55. Silver forms ccp lattice and X-ray studies of its crystals show that the edge length of its unit cell is 408.6 pm. Calculate density of silver (Atomic mass = 107.9 u)
56. An element (atomic mass = 60) having FCC unit cell has a density of  $6.23 \text{ g/cm}^3$ . What is the edge length of the unit cell?
57. An element (atomic mass = 27) has a density of  $2.7 \text{ g/cm}^3$ . If edge length of the cell is  $4.07 \times 10^{-8} \text{ cm}$ . what is the nature of the cubic unit cell?
58. Iron has bcc unit cell with cell edge of 286.65 pm. The density of iron is  $7.874 \text{ g/cm}^3$ . Calculate the value of Avogadro constant (atomic mass of Fe =  $56 \text{ g mol}^{-1}$ )
59. Determine the type of cubic lattices to which the iron crystal belongs if its unit cell has an edge length of 286 pm and the density of iron crystals is  $7.86 \text{ g/cm}^3$ .
60. The well known mineral fluorite is chemically calcium fluoride. It is known that in one unit cell of this mineral there are 4  $\text{Ca}^{2+}$  ions & 8  $\text{F}^-$  ions and that  $\text{Ca}^{2+}$  ions are arranged in a fcc lattice. The  $\text{F}^-$  ions fill all the tetrahedral holes in the fcc lattice of  $\text{Ca}^{2+}$  ions. The edge of the unit cell is  $5.46 \times 10^{-8} \text{ cm}$  in length. The density of solid is  $3.18 \text{ g/cm}^3$  in length. Using this information Calculate the value of Avogadro constant (Molar mass of  $\text{CaF}_2 = 78.08 \text{ g mol}^{-1}$ ).
61. An element has a body-centred cubic structure with a cell edge of 288 pm. The density of the element is  $7.2 \text{ g/cm}^3$ . How many atoms are present in 208 g of the element?
62. An element with molar mass  $2.7 \times 10^{-2} \text{ kg mol}^{-1}$  forms a cubic unit cell with edge length 405 pm. If its density is  $2.7 \times 10^3 \text{ kg m}^{-3}$ , what is the nature of the cubic unit cell?
63. An element crystallizes into a structure which may be described by a cubic lattice of unit cell having one atom on each corner of the cube and two atoms on one of its diagonals. If the volume of this unit cell is  $24 \times 10^{-24} \text{ cm}^3$  and density of element is  $7.2 \text{ g cm}^{-3}$ , calculate the number of atoms present in 200 g of the element.

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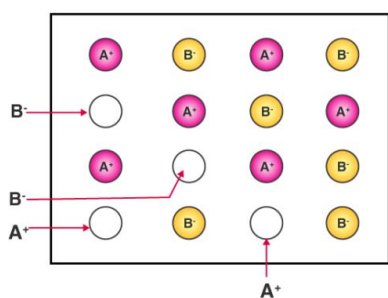
64. The density of copper metal is  $8.95 \text{ g/cm}^3$ . If the radius of copper atom be  $127.8 \text{ pm}$ , is the copper unit cell simple cubic, body centred cubic or face centred cubic?
65. An element X with an at. mass  $60 \text{ g/mol}$  has density  $6.23 \text{ g/cm}^3$ . If the edge length of cubic unit cell is  $400 \text{ pm}$ . Identify the type of cubic unit cell. Calculate the radius of an atom of this element.
66. An element crystallizes in BCC structure. If the edge length of the cell is  $1.469 \times 10^{-10} \text{ m}$ . & density is  $19.3 \text{ g/cm}^3$ . Calculate the at. Mass of this element. Also calculate the radius of an atom of this element.
67. Ag crystallizes in FCC lattice. The edge length of its unit cell is  $4.077 \times 10^{-8} \text{ cm}$ . & its density is  $10.5 \text{ g/cm}^3$ . Calculate the at. Mass of Ag.
68. An element has a body –centered cubic structure with a cell edge of  $314 \text{ pm}$ . The density of the element is  $10.3 \text{ g/cm}^3$ . Calculate the atomic mass of element.
69. Gold has a close-packed structure which can be viewed as-spheres  $0.74$  occupying of the total volume. If the density of gold is  $19.3 \text{ g/cc}$ , calculate the apparent radius of a gold ion in the solid
70. The edge length of a unit cell of a metal having molecular mass  $75 \text{ g/mol}$  is  $5 \text{ \AA}$  which crystallizes in a cubic lattice. If the density is  $2 \text{ gm cm}^{-3}$  then find the radius of metal atom.
71. KF has ccp structure. Calculate the radius of unit cell if the side of the cube or edge length is  $400 \text{ pm}$ . How many  $\text{F}^-$  ions and octahedral voids are there in this unit cell.
72. Calculate the value of Avogadro constant from the following data. Density of NaCl =  $2.165 \text{ g/cm}^3$ . Distance b/w  $\text{Na}^+$  &  $\text{Cl}^-$  is  $281 \text{ pm}$ .
73. What is meant by the term 'coordination number'?
74. What is the coordination number of atoms in a cubic close-packed structure.
75. What is the coordination number of atoms in a Hexagonal close packing hcp in 2-D & 3-D.
76. What is the two dimensional coordination number of a molecule in Square close packed layer. What is the coordination number of atoms in a Body centered cubic & Face centered cubic.
77. Write the 'coordination number' of Rock salt (NaCl) CsCl, ZnS, CaF<sub>2</sub> Fluorite .
78. How will you distinguish between the following pairs of terms: (i) Hexagonal close-packing and cubic close-packing (ii) Tetrahedral void and octahedral void
79. A cubic solid is made of two elements P and Q. Atoms of Q are at the corners of the cube and P at the body-centre. What is the formula of the compound? What are the coordination numbers of P and Q?
80. A cubic solid is made of two elements A and B. Atoms of A are at the corners of the cube and B at the Face-centre. What is the formula of the compound?
81. In a face centred cubic lattice, atom A occupies the corner positions and atom B occupies the face centre positions. If one atom of B is missing from one of the face centred points. What is the formula of the compound?
82. A compound is formed by two elements X and Y. Atoms of the element Y (as anions) make ccp and those of the element X (as cations) occupy all the octahedral voids. What is the formula of the compound?
83. Atoms of element B form hcp lattice and those of the element A occupy  $\frac{2}{3}$ rd of tetrahedral voids. What is the formula of the compound formed by the elements A and B?

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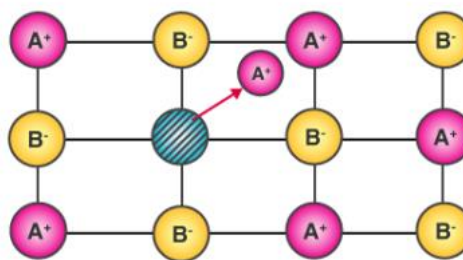
84. A compound forms hexagonal close-packed structure. What is the total number of voids in 0.5 mol of it? How many of these are tetrahedral voids?
85. A compound is formed by two elements M and N. The element N forms *ccp* and atoms of M occupy 1/3rd of tetrahedral voids. What is the formula of the compound?
86. Ferric oxide crystallises in a hexagonal close-packed array of oxide ions with two out of every three octahedral holes occupied by ferric ions. Derive the formula of the ferric oxide
87. If the radius of the octahedral void is  $r$  and radius of the atoms in close packing is  $R$ , derive relation between  $r$  and  $R$ .
88. Explain the following: (a) Point defect (b) intrinsic or thermodynamic defect (c) vacancy defect (d) interstitial defect
89. Explain the following with suitable examples : (a) Schottky defect (b) Frenkel defect (dislocation defect)
90. What is the effect of Schottky defect and Frenkel defects on the density of crystals.
91. What is the effect of Schottky defect on the density of crystals.
92. Name the crystal defect which lowers the density of an ionic crystal.
93. Which point defect increases the density of crystal?
94. Which point defect does not alter the density of crystal?
95. Why are Frenkel defects not found in pure alkali halides?
96. What type of defect can arise when a solid is heated?
97. Why are Frenkel defects found in  $\text{AgCl}$ ?
98. What type of stoichiometric defect is shown by  $\text{ZnS}$
99. What type of stoichiometric defect is shown by  $\text{AgBr}$
100. Explain how vacancies are introduced in an ionic solid when a cation of higher valence is added as an impurity in it?
101. What type of defect is produced when  $\text{NaCl}$  is doped with  $\text{SrCl}_2$ .
102. What is the nature of crystal defect produced when sodium chloride is doped with  $\text{MgCl}_2$  ?
103. What type of defect is produced when  $\text{AgCl}$  is doped with  $\text{CdCl}_2$
104. Define the term F-centers.
105. Ionic solids which have anionic vacancies due to metal excess develop colour. Explain with the example.
106. Name the non-stoichiometric defect responsible for colour in alkali halides.
107. What makes the crystal of  $\text{KCl}$  appear sometimes violet?
108. What is the effect of Frenkel defects on the density of crystals.
109. Why is Lithium chloride sometimes pink in colour?
110. Why common salt is sometime yellow instead of being pure white.
111. Mention one property which is caused due to presence of F-centre in a solid?
112. Zinc oxide is white but it turns yellow on heating. Why
113. What makes alkali metal halides sometimes coloured, which are otherwise colourless
114. Explain the following non-stoichiometric defects: (i) metal excess defect due to presence interstitial cation (ii) Metal deficiency defect.
115. A sample of ferrous oxide has actual formula  $\text{Fe}_{0.93}\text{O}_{1.00}$ . In this sample what fraction of metal ions are  $\text{Fe}^{2+}$  ions?
116. What type of nonstoichiometric defect is present in the sample of  $\text{Fe}_{0.93}\text{O}_{1.00}$ ?

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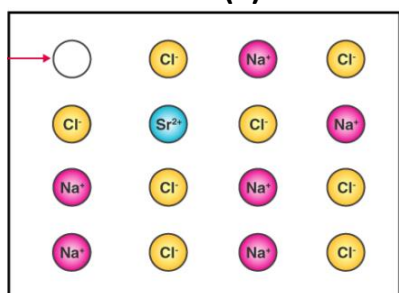
117. If NaCl is doped with  $10^{-3}$  mol % of  $\text{SrCl}_2$ , what is the concentration of cation vacancies.
118. Name a substance which on addition to AgCl causes cation vacancy in it.
119. Why is FeO (s) not formed in stoichiometric composition?
120. Why does zinc oxide exhibit enhanced electrical conductivity on heating ?
121. Name the defect in which equal number of cations and anions are missing from lattice positions .
122. Name the defect in which the smaller ion is dislocated from its normal site to an interstitial site.
123. Name the defect in which a negative ion from the crystal lattice may be missing from its lattice site leaving a hole or vacancy which is occupied by the electron originally associated with the anion
124. Name the defect type of defect generally occurs when metal shows variable valency.
125. Analysis shows that nickel oxide has the formula  $\text{Ni}_{0.98}\text{O}_{1.00}$ . What fractions of nickel exist as  $\text{Ni}^{+2}$  ions?
126. Identify the type of defects shown in following figures :



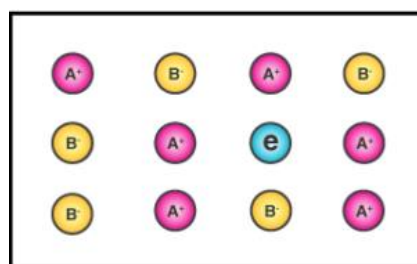
(a)



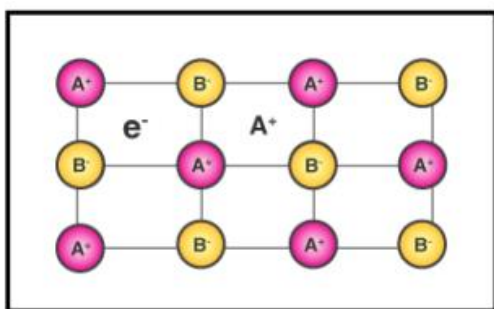
(c)



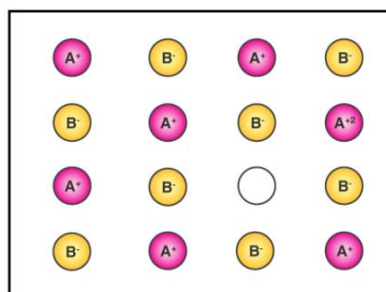
(b)



(d)



(e)



(f)

## **UNIT: 2:-SOLUTIONS**

1. Give one example of solution having gas as solute & gas as solvent.
2. Give one example of solution having liquid as solute & gas as solvent
3. Give one example of solution having solid as solute & gas as solvent.
4. Give one example of solution having gas as solute & liquid as solvent.
5. Give one example of solution having liquid as solute & liquid as solvent
6. Give one example of solution having solid as solute & liquid as solvent.
7. Give one example of solution having gas as solute & solid as solvent.
8. Give one example of solution having liquid as solute & solid as solvent
9. Give one example of solution having solid as solute & solid as solvent
10. Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water?(i) phenol (ii) toluene (iii) formic acid(iv) ethylene glycol (v) chloroform (vi) Pentanol.
11. Suggest the most important type of intermolecular attractive interaction in the following pairs.(i) n-hexane and n-octane(ii)  $I_2$  and  $CCl_4$ (iii)  $NaClO_4$  and water(iv) methanol and acetone (v) Acetonitrile ( $CH_3CN$ ) and acetone ( $C_3H_6O$ ).
12. Based on solute-solvent interactions, arrange the following in order of increasing solubility in n-octane and explain. Cyclohexane, KCl,  $CH_3OH$ ,  $CH_3CN$ .
13. Define: Molality, Molarity, Mass percentage, Volume percentage, Parts per million (ppm), Mole fraction. Write their formulas also.
14. Which out of the Molality & Molarity is better way to express the concentration of solution and why?
15. How does a change in temperature influence values of molarity and molality.
16. Concentration terms such as mass percentage, ppm, mole fraction and molality are independent of temperature, however molarity is a function of temperature.Explain.
17. Under what conditions molarity and molality of a solution nearly the same.
18. A solution is heated from  $25^\circ C$  to  $50^\circ C$ .Will its molarity be same less or more. Comment.
19. What is the sum of the mole fractions of all the components in a three component system?
20. State Henry law with its mathematical expressions. Explain the significance of Henry's law constant. At same temperature, hydrogen is more soluble in water than helium .Which will have larger value of  $K_H$
21. What is the significance of Henry's Law constant  $K_H$ ?
22. Mention some of important applications Henry law.
23. Why do gases always tend to be less soluble in liquids as the temperature is raised?
24. What is the effect of rise in temperature on solubility of a gas?
25. Why do aquatic species remain more comfortable in lakes in winters than in summers?
26. Explain the following phenomena with the help of Henry's law.(i) Painful condition known as bends. (ii) Feeling of weakness and discomfort in breathing at high altitude.
27. Why soda water bottle kept at room temperature fizzes on opening?
28. State Raoult's law for a solution of volatile liquids .Give its mathematical relationship.
29. How is the vapour pressure of a solvent affected when a non volatile solute is dissolved in it.
30. Why is vapour pressure of a solution of glucose in water lower than that of Water?



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31. What is an ideal solution? What type of solutions are likely to behave as ideal solutions? Draw the plot of vapour pressure and mole fraction of an ideal solution at constant temperature.
32. Explain along with diagrams the conditions for the Non ideal solutions exhibiting Positive deviations. Write some examples of Non ideal solutions exhibiting Positive deviations.
33. Explain along with diagrams the conditions for the Non ideal solutions exhibiting Negative deviations. Write some examples of Non ideal solutions exhibiting Negative deviations
34. Draw a diagram to illustrate the relationship between vapour pressure and mole fraction of a components in a solution to represent negative deviation.
35. What role does the molecular interaction play in solution of alcohol and water?
36. When X and Y are mixed the solution becomes warmer and Y and Z are mixed the solution becomes cooler? Which of these solutions will exhibit positive deviation and solutions will exhibit negative deviation?
37. What type of non idealities are exhibited by cyclohexane –ethanol and acetone-chloroform mixtures? Give reasons for your answer.
38. Why a mixture of carbondisulphide and acetone shows positive deviation from Raoult's law? What type of azeotropic mixture will be formed by this solution.
39. What are Azeotropes? Give one example each of minimum boiling and maximum boiling azeotropes.
40. In non ideal solution what type of deviation shows the formation of maximum boiling azeotrope.
41. In non ideal solution what type of deviation shows the formation of minimum boiling azeotrope.
42. Components of a binary mixture of two liquids A and B were being separated by distillation. After some time separation of components stopped and composition of vapour phase became same as that of liquid phase. Both the components started coming in the distillate. Explain why this happened.
43. What general name is given to binary mixtures which show deviation from Raoult's law and whose components cannot be separated by fractional distillation. How many types of such mixtures are there?
44. Acetone (bp329K) and carbon disulphide (bp320K) are mixed in a definite composition so that the mixture of two behaves like pure liquid and boils at 312 what name can be given to such a mixture?
45. 10cc of a liquid A is mixed with 10 cc of liquid B. The volume of resulting solution was found to be 19.9cc. what do you conclude.
46. What type of azeotropic mixture will be formed by the solution of acetone-chloroform mixtures? Justify on the basis of strength of intermolecular interactions that develop in the solution.
47. Define colligative properties.
48. Show that Relative Lowering of vapour pressure is a colligative property.
49. Why does a solution containing no volatile solute have higher boiling point than pure solvent. Show that Elevation of boiling point is a colligative property
50. How will you determine the molecular mass of a non volatile substance by study of Elevation of boiling point of a solution?

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51. Out of 1M glucose and 2M glucose which one has a higher boiling point and why.
52. What is molal elevation constant? What are its units? How is it related to enthalpy of vaporization of solvent?
53. Why common salt is added to water used for boiling eggs to get hard boiled eggs?
54. 10 g of sucrose and 10 g of glucose are dissolved in same volume of water to prepare two solutions X and Y .will they have same or different boiling points?
55. Show that depression of freezing point is a colligative property.
56. How will you determine the molecular mass of a non volatile substance by study of depression of freezing point of a solution.
57. An aqueous solution of sodium chloride freezes below 273 K.Explain the lowering in freezing point of water with the help of a suitable diagram.
58. What is molal depression constant? What are its units? How is it related to enthalpy of fusion of solvent?
59. How does sprinkling of salt help in clearing the snow covered roads in hilly areas? Explain the phenomenon involved in the process.
60. What are antifreeze solutions? Which substance is commonly used as antifreeze?
61. What is osmotic pressure? Show that it is a colligative property.
62. Define (i)Semi permeable membrane(ii) osmosis (iii) isotonic (iv) Hypertonic (v) Hypotonic solution.
63. What is edema.
64. What is reverse osmosis? Give its application.
65. When kept in water, raisin swells in size. Name and explain the phenomenon involved with the help of a diagram. Give three applications of the phenomenon.
66. Discuss biological and industrial importance of osmosis.
67. How can you remove the hard calcium carbonate layer of the egg without damaging its semipermeable membrane? Can this egg be inserted into a bottle with a narrow neck without distorting its shape? Explain the process involved
68. Give an example of a material used for making semipermeable membrane for carrying out reverse osmosis
69. What care is generally taken during intravenous injection and why?
70. What happens when the external pressure applied becomes more than the osmotic pressure of the solution.
71. How will you determine the molecular mass of a substance by study of osmotic pressure
72. Measurement of osmotic pressure method is preferred for the determination of molecular masses of macromolecules such as proteins and polymers.Give two reasons.
73. What will happen if RBC are placed in (i)0.5% NaCl Solution (ii)1% NaCl Solution?
74. What happens when we place the blood cell in water (hypertonic solution).Give reason.
75. Give reason :
  - a) A raw mango placed in concentrated salt solution shrivels into pickle.
  - b) Wilted flowers revive when placed in fresh water.
  - c) A carrot that has become limp placed into the water making it firm once again.
  - d) Water movement from soil into plant roots and subsequently into upper portion of the plant
  - e) The preservation of meat by salting and of fruits by adding sugar protects against bacterial action.

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76. Calculate the molarity of a solution containing 5 g of NaOH in 450ml solution.
77. Concentrated nitric acid used in the laboratory work is 68% nitric acid by mass in aqueous solution. What should be the molarity of such a sample of the acid if the density of the solution is 1.504 g/ml?
78. Calculate the amount of benzoic acid required for preparing 250 ml of 0.15M solution in methanol.
79. Calculate molality of 2.5g of ethanoic acid ( $\text{CH}_3\text{COOH}$ ) in 75g of benzene.
80. Calculate the mass of urea ( $\text{NH}_2\text{CONH}_2$ ) required in making 2.5 Kg of 0.25 molal of aqueous solution.
81. Calculate the molarity of each of the following solutions : ( a) 30g of  $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  in 4.3L of solution (b) 30ml of 0.5 $\text{H}_2\text{SO}_4$  diluted to 500ml.
82. An antifreeze solution is prepared from 222.6g of ethylene glycol.  $\text{C}_2\text{H}_4(\text{OH})_2$  and 200g of water. Calculate molality of solution. If the density of the solution is 1.072 g/ml then what shall be the molarity of the solution?
83. Calculate Molality, Molarity & Mole fraction of KI if the density of 20 % ( mass/mass) aqueous KI is 1.202g/ml.
84. A solution of glucose in water is labelled as 10% w/w. What should be the molality and mole fraction of each component in the solution? If the density of solution is 1.2g/ml, then what shall be the molarity of the solution?
85. If the density of some lake water is 1.25 g/ml and contains 92g of  $\text{Na}^+$  ions per Kg of water, calculate the molality and molarity of  $\text{Na}^+$  ions in the lake.
86. Calculate the mole fraction of ethylene glycol.  $\text{C}_2\text{H}_4(\text{OH})_2$  in a solution containing 20% of ethylene glycol.  $\text{C}_2\text{H}_4(\text{OH})_2$  by mass.
87. Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride ( $\text{CCl}_4$ ).
88. A sample of drinking water was found to be contaminated with chloroform ( $\text{CHCl}_3$ ) supposed to be carcinogen. The level of contamination was 15ppm (By mass). (i) Express this in percent by mass. (ii) determine the molality of chloroform in the water sample.
89. Calculate the mass percentage of aspirin ( $\text{C}_9\text{H}_8\text{O}_4$ ) in acetonitrile ( $\text{CH}_3\text{CN}$ ) when 6.5g of ( $\text{C}_9\text{H}_8\text{O}_4$ ) is dissolved in 450g of ( $\text{CH}_3\text{CN}$ ).
90. Calculate the mass percentage of benzene ( $\text{C}_6\text{H}_6$ ) and carbon tetrachloride ( $\text{CCl}_4$ ) if 22g of benzene is dissolved in 122g of carbon tetrachloride ( $\text{CCl}_4$ ).
91. Calculate the percentage composition in terms of mass of a solution obtained by mixing 300g of a 25% and 400g of 40% solution by mass
92. If the solubility product of CuS is  $6 \times 10^{-16}$ , calculate the maximum molarity of CuS in aqueous solution.
93. Nalorphene ( $\text{C}_{19}\text{H}_{21}\text{NO}_3$ ), similar to morphine is used to combat withdrawal symptoms in narcotic users .Dose of Nalorphene, generally is 1.5 mg. Calculate the mass of  $1.5 \times 10^{-3}$  molal aq.
94. If  $\text{N}_2$  gas is bubbled through water at 298 K, how many millimoles of  $\text{N}_2$  gas would dissolve in 1 litre of water .Assume that  $\text{N}_2$  exerts a partial pressure of 0.987 bar . Henry's law constant for  $\text{N}_2$  at 293K is 76.48 bar.
95.  $\text{H}_2\text{S}$  a toxic gas with rotten egg like smell is used for the qualitative analysis. If the solubility of  $\text{H}_2\text{S}$  in water at STP is 0.195m, calculate Henry's law constant

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96. Henry's law constant for  $\text{CO}_2$  in water is  $1.67 \times 10^8 \text{ Pa}$  at  $298 \text{ K}$ . Calculate the quantity of  $\text{CO}_2$  in  $500 \text{ ml}$  of soda water when packed under  $2.5 \text{ atm}$   $\text{CO}_2$  pressure at  $298 \text{ K}$ .
97. The partial pressure of ethane over a solution containing  $6.56 \times 10^{-3} \text{ g}$  of ethane is  $1 \text{ bar}$ . If the solution contains  $5.00 \times 10^{-2} \text{ g}$  of ethane, then what shall be the partial pressure of the gas?
98. Henry's law constant for the molality of methane in benzene at  $298 \text{ K}$  is  $4.27 \times 10^5 \text{ mm Hg}$ . Calculate the solubility of methane in benzene at  $298 \text{ K}$  under  $760 \text{ mm Hg}$ .
99. Vapour pressure of chloroform ( $\text{CHCl}_3$ ) and dichloroform ( $\text{CH}_2\text{Cl}_2$ ) at  $298 \text{ K}$  are  $200 \text{ mm Hg}$  and  $415 \text{ mm Hg}$  respectively. (i) Calculate the vapour pressure of the solution prepared by mixing  $25.5 \text{ g}$  of  $\text{CHCl}_3$  and  $40.0 \text{ g}$  of  $\text{CH}_2\text{Cl}_2$  at  $298 \text{ K}$  and (ii) mole fractions of each component in vapour phase.
100. The vapour pressure of pure liquids A and B are  $450$  and  $700 \text{ mm Hg}$  respectively at  $350 \text{ K}$ . Find out the composition of the liquid mixture if total vapour pressure is  $600 \text{ mm Hg}$ . Also find the composition of the vapour phase.
101. Heptane and Octane form ideal solution. At  $373 \text{ K}$ , the vapour pressures of the two liquid components are  $105.2 \text{ kPa}$  and  $46.8 \text{ kPa}$  respectively. What will be the vapour pressure, in bar of a mixture of  $25.0 \text{ g}$  heptane and  $35.0 \text{ g}$  of octane?
102. Benzene and toluene ( $\text{C}_7\text{H}_8$ ) form ideal solution over entire range of composition. The vapour pressure of pure benzene and toluene at  $300 \text{ K}$  are  $50.71 \text{ mmHg}$  and  $32.06 \text{ mmHg}$  respectively. Calculate mol fraction of benzene in vapour phase if  $80 \text{ g}$  of benzene is mixed with  $100 \text{ g}$  toluene.
103.  $100 \text{ g}$  of liquid A (molar mass  $140 \text{ g/mol}$ ) was dissolved in  $1000 \text{ g}$  of liquid B (molar mass  $180 \text{ g/mol}$ ) the vapour pressure of pure B was found to be  $500 \text{ torr}$ . Calculate the vapour pressure of pure A and its vapour pressure in solution if total vapour pressure of a solution is recorded as  $475 \text{ torr}$ .
104. Vapour pressure of water at  $293 \text{ K}$  is  $17.535 \text{ mm Hg}$ . Calculate vapour pressure of water at  $293 \text{ K}$  when  $25 \text{ g}$  of glucose is dissolved in  $450 \text{ g}$  of water.
105. A solution is prepared by dissolving  $10 \text{ g}$  of non volatile solute in  $200 \text{ g}$  of water. It has a vapour pressure of  $31.84 \text{ mm}$  of  $\text{Hg}$  at  $308 \text{ K}$ . Calculate the molar mass of the solute. (Vapour pressure of pure water at  $308 \text{ K}$  is  $32 \text{ mm}$  of  $\text{Hg}$ .)
106. At  $25^\circ\text{C}$  the saturated vapour pressure of water is  $3.165 \text{ k Pa}$  ( $23.75 \text{ mm Hg}$ ). Find the saturated vapour pressure of a  $5\%$  aqueous solution of urea at same temperature. (molar mass of urea =  $60.05 \text{ g/mol}$ )
107. The vapour pressure of pure benzene at a certain temperature is  $0.850 \text{ bar}$ . A non volatile, non electrolyte solid weighing  $0.5 \text{ g}$  when added to  $39.0 \text{ g}$  benzene (molar mass  $78 \text{ g/mol}$ ). vapour pressure of the solution, then is  $0.845 \text{ bar}$ . what is the molar mass of the solid substance?
108. Calculate the mass of a nonvolatile solute (molecular mass =  $40$ ) which should be dissolved in  $114 \text{ g}$  octane to reduce its vapour pressure to  $80\%$ .
109. A solution containing  $30 \text{ g}$  of non-volatile solute exactly in  $90 \text{ g}$  water has a vapour pressure of  $2.8 \text{ kPa}$  at  $298 \text{ K}$ . Further  $18 \text{ g}$  of water is then added to solution, the new vapour pressure becomes  $2.9 \text{ kPa}$  at  $298 \text{ K}$ . Calculate (a) Molecular mass of solute (b) Vapour pressure of water at  $298 \text{ K}$
110. An aqueous solution of  $2\%$  nonvolatile solute exerts a pressure of  $1.004 \text{ bar}$  at the boiling point of the solvent. what is the molecular mass of the solute? (Vapour pressure of pure water =  $1 \text{ atm} = 1.013 \text{ bar}$ )

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111. Vapour pressure of pure water at 298 K is 23.8 mmHg .50 g of urea ( $\text{NH}_2\text{CONH}_2$ ) is dissolved in 850 g of water .calculate the vapour pressure of water for this solution and its relative lowering.
112. The vapour pressure of water is 12.3 kPa at 300 K. Calculate vapour pressure of 1 molal solution of a non-volatile solute in it.
113. 18 g glucose  $\text{C}_6\text{H}_{12}\text{O}_6$  is dissolved in 1 kg of water in a saucepan. At what temperature will solution boil?  $K_b$  for water is  $0.512 \text{ K kg mol}^{-1}$ .
114. Find the boiling point of a solution containing 0.520 g of glucose dissolved in 80.2 g of water.  $K_b$  for water is  $0.52 \text{ K kg mol}^{-1}$ .
115. A solution of glycerol( $\text{C}_3\text{H}_8\text{O}_3$ ) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of  $100.42^\circ\text{C}$ . What mass of glycerol was dissolved to make this solution? ( $K_b$  for water =  $0.512 \text{ K kg mol}^{-1}$ )
116. The boiling point of benzene is 353.23K.when 1.80 g of a non volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11K.Calculate the molar mass of the solute?  $K_b$  for benzene is  $2.53 \text{ K kg mol}^{-1}$ .
117. Boiling point of water at 750 mmHg is  $99.63^\circ\text{C}$ .How much sucrose is to added to 500 g water such that it boils at  $100^\circ\text{C}$ .
118. What would be the molar mass of a compound if 6.21 g of its dissolved in 24 g of chloroform to form a solution that has a boiling point of  $68.04^\circ\text{C}$  .The boiling point of pure chloroform is  $61.7^\circ\text{C}$  and  $K_b$  for chloroform is  $3.63^\circ\text{C}/m$ .
119. A solution of 3.800 g of sulphur in 100 g of  $\text{CS}_2$  (boiling point =  $46.30^\circ\text{C}$ ) boils at  $46.66^\circ\text{C}$ . What is the formula of sulphur molecule in this solution ? (Atomic mass of sulphur =  $32 \text{ g mol}^{-1}$  and  $K_b$  for  $\text{CS}_2$  =  $2.40 \text{ K kg mol}^{-1}$ )
120. A solution prepared by dissolving 1.25g of oil of wintergreen in 99.0g of benzene has a boiling point of  $80.31^\circ\text{C}$  .Determine the molar mass of this compound(B.P. of pure benzene =  $80.10^\circ\text{C}$  and  $K_b$  for benzene is  $2.53 \text{ K kg mol}^{-1}$ ..)
121. 1.00 g of non-electrolyte solute is dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40K.The freezing point depression constant of benzene is  $5.12 \text{ K kg mol}^{-1}$  .Find the molar mass of the solute.
122. 45g of ethylene glycol ( $\text{C}_2\text{H}_6\text{O}_2$ ) is mixed with 600g of water .calculate (a)Freezing point depression (b)Freezing point of the solution.  $K_f$  for water =  $1.86 \text{ K kg mol}^{-1}$
123. Calculate the mass of ascorbic acid ( $\text{C}_6\text{H}_8\text{O}_6$ ) to be dissolved in 75g of acetic acid to lower its melting point by  $1.5^\circ\text{C}$ .  $K_f$  for acetic acid =  $3.9 \text{ K kg mol}^{-1}$
124. A solution containing 2.56 gm of sulphur in 100 g of carbon disulphide gave a freezing point lowering of 0.383 K .Calculate the molecular formulae of Sulphur [  $k_f$  of carbon disulphide =  $3.83 \text{ K kg/mol}$  Atomic mass of S =32 amu]
125. 15g of an unknown molecular substance was dissolved in 450g of water.The resulting solution freezes at  $-0.34^\circ\text{C}$ .What is the molar mass of the substance.
126. What mass of ethylene glycol(molar mass =62) must be added to 5.50kg of water to lower the freezing point from  $0^\circ\text{C}$  to  $-10^\circ\text{C}$ ? ( $K_f$  for water =  $1.86 \text{ K kg mol}^{-1}$ )
127. Two elements A & B form compounds having molecular formula  $\text{AB}_2$  &  $\text{AB}_4$ . When dissolved in 20g of  $\text{C}_6\text{H}_6$ , 1g  $\text{AB}_2$  lowers the freezing point by 2.3 & 1.0g  $\text{AB}_4$  lowers it by 1.3K.The molar depression constant for benzene is  $5.1 \text{ K kg mol}^{-1}$ . Calculate atomic mass A & B.
128. A 5% solution (by mass) of cane sugar in water has freezing point of 271.15 K. calculate the freezing point of 5% glucose in water if freezing point of water is 273.15 K.

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129. A 4% solution (by mass) of sucrose in water has freezing point of 271 K. calculate the freezing point of 5% glucose in water if freezing point of water is 273.15 K.
130. Calculate the temperature at which a solution containing 54g of glucose in 250g of water will freeze.  $K_f$  for water is  $1.86 \text{ K kg mol}^{-1}$ .)
131. In a solution of urea, 3.0 g of its is dissolved in 100 ml of water. What will be the freezing point of this solution ? State the approximation made if any. [ $K_f$  for water =  $1.86 \text{ K kg mol}^{-1}$ , molar mass of Urea =  $60 \text{ g mol}^{-1}$ ]
132. Some ethylene glycol ( $\text{C}_2\text{H}_6\text{O}_2$ ) is added to your cars cooling system along with 5 kg of water.If the freezing point water-glycerol is  $-15^\circ\text{C}$  ,what is the boiling point of the solution? ( $K_f=1.86 \text{ K kg mol}^{-1}$  &  $K_b=0.52 \text{ K kg mol}^{-1}$  for water)
133.  $200 \text{ cm}^3$  of an aqueous solution of a protein contains 1.26 g of the protein .The osmotic pressure of such a solution at 300K is found to be  $2.57 \times 10^{-3} \text{ bar}$ .calculate the molar mass of the protein .
134. 10.0 gm of an organic substance when dissolved in 2 litres of water gave an osmotic pressure of 0.60 atm. at  $27^\circ\text{C}$  Calculate the molecular mass of substance.
135. Calculate the osmotic pressure in Pascals exerted by a solution prepared by dissolving 1.0 g of polymer of molar mass 185,000 in 450ml of water at  $37^\circ\text{C}$ .
136. At 300 k, 36g of glucose present per litre in its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of solution is 1.52 bars at the same temperature, what would be the concentration?
137. A 5 % solution of canesugar is isotonic with 0.877% of substance X.Find the molecular weight of X.
138. 100 mg of a protein is dissolved in enough water to make 10ml of a solution. If this solution has an osmotic pressure of 13.3 mm Hg at  $25^\circ\text{C}$ ,what is the molar mass of protein?( $R=0.0821 \text{ Latm mol}^{-1} \text{ K}^{-1}$  and  $760 \text{ mmHg}=1 \text{ atm}$ )
139. A solution prepared by dissolving 8.95mg of a gene fragment in 35.0ml of water has an osmotic pressure of 0.335 torr at  $25^\circ\text{C}$  .Calculate its molar mass.

## UNIT: 3:-ELECTROCHEMISTRY

1. Define Electrochemical cell. What happens when applied external opposite potential becomes greater than  $E^\circ_{\text{cell}}$  of electrochemical cell.
2. Explain the working of the galvanic cell by taking an example.
3. Explain the function of the salt bridge.
4. Which reference electrode is used to measure the electrode potential of other electrodes?
5. Write the Nernst equation for the cell reaction in the Daniel cell. How will the  $E_{\text{cell}}$  be affected when concentration of  $\text{Zn}^{2+}$  ions is increased?
6. Consider a cell given below  $\text{Cu} | \text{Cu}^{2+} || \text{Cl}^- | \text{Cl}_2, \text{Pt}$  Write the reactions that occur at anode and cathode
7. A galvanic cell has electrical potential of 1.1V. If an opposing potential of 1.1V is applied to this cell, what will happen to the cell reaction and current flowing through the cell?
8. Write the Nernst equation and emf of the following cells at 298K:
  - a)  $\text{Mg(s)} / \text{Mg}^{2+}(0.001\text{M}) // \text{Cu}^{2+}(0.0001) / \text{Cu(s)}$ ;  $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ ,  $E^\circ_{\text{Mg}^{2+}/\text{Mg}} = -2.36$
  - b)  $\text{Fe(s)} / \text{Fe}^{2+}(0.001\text{M}) // \text{H}^+(1\text{M}) / \text{H}_2(\text{g}) / \text{Pt(s)}$   $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44\text{V}$
  - c)  $\text{Zn} / \text{Zn}^{2+}(0.1\text{M}) // \text{Cd}^{2+}(0.01) / \text{Cd}$ ;  $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$ ,  $E^\circ_{\text{Cd}^{2+}/\text{Cd}} = -0.40\text{V}$
  - d)  $\text{Cu} / \text{Cu}^{2+}(2\text{M}) // \text{Ag}^+(0.05\text{M}) / \text{Ag}$ ;  $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ ,  $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80\text{V}$
  - e)  $\text{Mg(s)} / \text{Mg}^{2+}(10^{-3}\text{M}) // \text{Cu}^{2+}(10^{-4}\text{M}) / \text{Cu(s)}$ ;  $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ ,  $E^\circ_{\text{Mg}^{2+}/\text{Mg}} = -2.36$
  - f)  $\text{Zn} / \text{Zn}^{2+}(2\text{M}) // \text{Cu}^{2+}(0.5\text{M}) / \text{Cu}$ ;  $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$ ,  $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34\text{V}$
  - g)  $\text{Sn} / \text{Sn}^{2+}(0.050\text{M}) // \text{H}^+(0.020\text{M}) / \text{H}_2(\text{g}) / \text{Pt(s)}$   $E^\circ_{\text{Sn}^{2+}/\text{Sn}} = -0.14\text{V}$
  - h)  $\text{Sn} / \text{Sn}^{2+}(0.04\text{M}) // \text{H}^+(0.02\text{M}) / \text{H}_2(\text{g}) / \text{Pt(s)}$   $E^\circ_{\text{Sn}^{2+}/\text{Sn}} = -0.14\text{V}$
  - i)  $\text{Pt(s)} / \text{Br}_2(\text{l}) / \text{Br}^-(0.010) // \text{H}^+(0.030\text{M}) / \text{H}_2(\text{g}) / \text{Pt(s)}$
9. Calculate the emf of the cell at 25°C for the following :
  - a)  $\text{Mg(s)} + 2\text{Ag}^+(0.0001\text{M}) \rightarrow \text{Mg}^{2+}(0.130\text{M}) + 2\text{Ag(s)}$ . if  $E^\circ_{\text{cell}} = 3.17\text{V}$ .
  - b)  $\text{Ni(s)} + 2\text{Ag}^+(0.002\text{M}) \rightarrow \text{Ni}^{2+}(0.160\text{M}) + 2\text{Ag(s)}$ , Given  $E^\circ_{\text{cell}} = 1.05\text{V}$
  - c)  $2\text{Cr(s)} + 3\text{Fe}^{2+}(0.1\text{M}) \rightarrow 2\text{Cr}^{3+}(0.01\text{M}) + 3\text{Fe(s)}$   $E^\circ_{\text{Cr}^{3+}/\text{Cr}} = -0.74\text{V}$ ,  $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44\text{V}$
10. The emf of the cell  $\text{Zn} / \text{Zn}^{2+}(0.1\text{M}) // \text{Cd}^{2+}(M_1) / \text{Cd}$  has been found to be 0.3035 V at 298K. Calculate the value of  $M_1$ .  $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$ ,  $E^\circ_{\text{Cd}^{2+}/\text{Cd}} = -0.40\text{V}$ .
11. Calculate the potential for half cell containing .10M  $\text{K}_2\text{Cr}_2\text{O}_7(\text{aq})$ , 0.20M  $\text{Cr}^{3+}(\text{aq})$  and  $1.0 \times 10^{-4} \text{H}^+(\text{aq})$ , The half cell reaction is  $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14 \text{H}^+(\text{aq}) + 6\text{e}^- \rightarrow 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$  and the Standard cell potential  $E^\circ_{\text{cell}} = 1.33\text{V}$
12. How would you determine the standard electrode potential of the system  $\text{Mg}^{2+} | \text{Mg}$ ?
13. Calculate the potential of hydrogen electrode in contact with a solution whose pH is 10.
14. A Zinc rod is dipped in 0.1M solution of  $\text{ZnSO}_4$ . The salt is 95% dissociated at this dilution at 298K. Calculate the electrode potential.
15. Using the  $E^\circ$  values of X & Y predict which is better for coating the surface of iron to prevent rust and why?  $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44\text{V}$ ,  $E^\circ_{\text{X}^{2+}/\text{X}} = -2.36\text{V}$ ,  $E^\circ_{\text{Y}^{2+}/\text{Y}} = -0.14\text{V}$
16. Calculate the emf of the cell. The following chemical reaction is occurring in an electrochemical cell.  
$$\text{Mg(s)} + 2\text{Ag}^+(0.0001\text{M}) \rightarrow \text{Mg}^{2+}(0.10\text{M}) + 2\text{Ag(s)}$$
The electrode values are  $\text{Mg}^{2+} / \text{Mg} = -2.36\text{V}$   $\text{Ag}^+ / \text{Ag} = 0.81\text{V}$ . For this cell calculate / write (a) (i)  $E^\circ$  value for the electrode  $2 \text{Ag}^+ / \text{Ag}$  (ii) Standard cell potential  $E^\circ_{\text{cell}}$ . (b) Cell potential ( $E_{\text{cell}}$ ) (c) (i) Symbolic representation of the above cell. (ii) Will the above cell reaction be spontaneous?
17. A voltaic cell is constructed at 25°C with the following half cell  $\text{Ag}^+(0.001\text{M}) / \text{Ag}$  and  $\text{Cu}^{2+}(0.01\text{M}) / \text{Cu}$  what would be the voltage of this cell? Given  $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80\text{V}$ ,  $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ .

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18. A Copper –silver is set up. The copper ion concentration in it is 0.10M. The concentration of silver is not known. The cell potential measured is 0.422V. Determine the concentration of silver ion in the cell.  $E^{\circ}_{\text{Ag}^+/\text{Ag}} = +0.80\text{V}$ ,  $E^{\circ}_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ .
19. One half cell in a voltaic cell is constructed from a silver wire dipped in silver nitrate solution of unknown concentration. The other half cell consists of a zinc electrode in a 0.10M solution of Zinc nitrate. A voltage of 1.48V is measured for this cell. Use this information to calculate the concentration of silver nitrate solution. ( $E^{\circ}_{\text{Zn}^{2+}/\text{Zn}} = -0.763\text{V}$ ,  $E^{\circ}_{\text{Ag}^+/\text{Ag}} = +0.80\text{V}$ )
20. A voltaic cell is set up at 25°C With the following half cells :Al(s)/Al<sup>3+</sup>(0.001M) and Ni<sup>2+</sup>(0.50)/Ni(s), Write the equation for the cell reaction that occurs when the cell generates an electric current and determine the cell potential (given  $E^{\circ}_{\text{Ni}^{2+}/\text{Ni}} = -0.25\text{V}$ ,  $E^{\circ}_{\text{Al}^{3+}/\text{Al}} = -1.66\text{V}$ )
21. What is the relationship between Gibbs free energy of the cell reaction in a galvanic cell and the emf of the cell? When will the maximum work be obtained from a galvanic cell?
22. Calculate  $\Delta_r G^{\circ}$  & value of equilibrium constant for the following :
  - a) Mg(s)/Mg<sup>2+</sup>//Cu<sup>2+</sup>/Cu(s);  $E^{\circ}_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ ,  $E^{\circ}_{\text{Mg}^{2+}/\text{Mg}} = -2.36$
  - b) Zn(s) + Cu<sup>2+</sup>  $\rightleftharpoons$  Zn<sup>2+</sup> + Cu  $E^{\circ}_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ ,  $E^{\circ}_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$
  - c) Cu (s) + 2Ag<sup>+</sup>  $\rightleftharpoons$  Cu<sup>2+</sup> + 2Ag(s)  $E^{\circ}_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ ,  $E^{\circ}_{\text{Ag}^+/\text{Ag}} = +0.80\text{V}$
  - d) 2Fe<sup>3+</sup> + 2I<sup>-</sup>  $\rightarrow$  2Fe<sup>2+</sup> + I<sub>2</sub> has  $E^{\circ}_{\text{cell}} = 0.236\text{V}$
  - e) Fe<sup>2+</sup>(aq) + Ag<sup>+</sup>  $\rightarrow$  Fe<sup>3+</sup>(aq) + Ag(s),  $E^{\circ}_{\text{Ag}^+/\text{Ag}} = +0.80\text{V}$ ,  $E^{\circ}_{\text{Fe}^{3+}/\text{Fe}^{2+}} = +0.77\text{V}$
  - f) 2Cr(s) + 3Cd<sup>2+</sup>  $\rightarrow$  2Cr<sup>3+</sup> + 3Cd(s)  $E^{\circ}_{\text{Cr}^{3+}/\text{Cr}} = -0.74\text{V}$ ,  $E^{\circ}_{\text{Cd}^{2+}/\text{Cd}} = -0.40\text{V}$
23. Calculate the equilibrium constant for the reaction. Calculate the equilibrium constant for the reaction. In the button cell widely used in watches and devices the following reaction takes place: Zn (s) + Ag<sub>2</sub>O(s) + H<sub>2</sub>O(l)  $\rightarrow$  Zn<sup>2+</sup>(aq) + 2 Ag(s) + 2OH<sup>-</sup> (aq) Determine  $\Delta_r G^{\circ}$  &  $E^{\circ}$  for the reaction.  $E^{\circ}_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$ ,  $E^{\circ}_{\text{Ag}^+/\text{Ag}} = +0.80\text{V}$
24. Calculate emf and  $\Delta G$  for the following cell : Mg(s)/Mg<sup>2+</sup>(0.001M)//Cu<sup>2+</sup>(0.0001M)/Cu(s);  $E^{\circ}_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ ,  $E^{\circ}_{\text{Mg}^{2+}/\text{Mg}} = -2.37\text{V}$
25. Calculate  $\Delta_r G^{\circ}$  for the reaction at 25°C : Au(s) + Ca<sup>2+</sup> (1 M)  $\rightarrow$  Au<sup>3+</sup>(1M) + Ca (s),  $E^{\circ}_{\text{Ca}^{2+}/\text{Ca}} = -2.87\text{V}$ ,  $E^{\circ}_{\text{Au}^{3+}/\text{Au}} = +1.50\text{V}$ . Predict whether the reaction will be spontaneous or not at 25°C which of the above two half cells will act as an oxidizing agent and which one will be a reducing agent?
26. Depict the galvanic cell in which the reaction: Zn + Ag<sup>+</sup>  $\rightarrow$  Zn<sup>2+</sup> + 2Ag takes place. Further show: (a) Which of the electrode is negatively charged? (b) The carriers of the current in the cell. (c) Individual reaction at each electrode.
27. Two half cell reactions of an electrochemical cell are given below:
  - (i) MnO<sub>4</sub><sup>-</sup> + 8 H<sup>+</sup> + 5 e<sup>-</sup>  $\rightarrow$  Mn<sup>2+</sup> + 4 H<sub>2</sub>O  $E^{\circ} = +1.51\text{V}$
  - (ii) Sn<sup>2+</sup>  $\rightarrow$  Sn<sup>4+</sup> + 2e<sup>-</sup>  $E^{\circ} = +0.15\text{V}$ .
 Construct the redox reaction from the two half cell reaction and predict if the reaction favours formation of reactants or product shown in the reaction
28. Given the standard electrode potentials,  $K^+/\text{K} = -2.93\text{V}$ ,  $\text{Ag}^+/\text{Ag} = 0.80\text{V}$ ,  $\text{Hg}^{2+}/\text{Hg} = 0.79\text{V}$ ,  $\text{Mg}^{2+}/\text{Mg} = -2.37\text{V}$ ,  $\text{Cr}^{3+}/\text{Cr} = -0.74\text{V}$ . Arrange these metals in their increasing order of reducing power
29. Tarnished silver contains Ag<sub>2</sub>S. Can this tarnish be removed by placing tarnished silver ware in an aluminium pan containing an inert electrolytic solution such as NaCl. The standard electrode potential for half reaction : Al<sup>3+</sup> + 3e<sup>-</sup>  $\rightarrow$  Al is -1.66 and Ag<sub>2</sub>S + 2e<sup>-</sup>  $\rightarrow$  2Ag<sup>+</sup> + S<sup>2-</sup> is -0.71
30. Define conductivity, molar conductivity & limiting molar conductivity.
31. Distinguish between Electrical conductance & Electrolytic (ionic conductance)



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32. Express the relation among the cell constant, the resistance of the solution in the cell and the conductivity of the solution. How is the conductivity of a solution related to its molar conductivity.
33. The resistance of 0.01M NaCl solution at 25°C is 200ohm. The cell constant of the conductivity cell is unity. Calculate the molar conductivity of the solution.
34. The conductivity of 0.20M solution of KCl at 298 K is 0.0248S cm<sup>-1</sup>. Calculate its molar conductivity.
35. The Molar conductivity of a 1.5M solution of an electrolyte is found to be 138.9 S cm<sup>2</sup> mol<sup>-1</sup>. Calculate the conductivity of this solution.
36. The resistance of conductivity cell containing 0.001M KCl at 298K is 1500 ohm. What is cell constant if conductivity of 0.001M KCl at 298K is 0.146X 10<sup>-3</sup>S cm<sup>-1</sup>.
37. When a certain conductance cell was filled with 0.1M KCl solution it has resistance of 85 ohm at 25°C. When the same cell was filled with an aqueous solution of 0.052M of unknown electrolyte the resistance was 96ohm. Calculate the molar conductivity of electrolyte. The conductivity of 0.1 M solution of KCl is 1.29 x 10<sup>-2</sup>S cm<sup>-1</sup>.
38. Resistance of conductivity cell filled with 0.1mol<sup>-1</sup> KCl solution is 100 ohm. If the resistance of the same cell when filled with 0.02mol<sup>-1</sup> KCl solution is 520 ohm. Calculate the conductivity & molar conductivity of 0.02mol<sup>-1</sup> KCl solution. The conductivity of 0.1 mol<sup>-1</sup> solution of KCl is 1.29S m<sup>-1</sup>.
39. Resistance of conductivity cell filled with 0.1mol<sup>-1</sup> KCl solution is 100 ohm. If the resistance of the same cell when filled with 0.02mol<sup>-1</sup> KCl solution is 520 ohm. Calculate the conductivity & molar conductivity of 0.02mol<sup>-1</sup> KCl solution. The conductivity of 0.1 mol<sup>-1</sup> solution of KCl is 1.29S m<sup>-1</sup>.
40. The electrical resistance of a column of 0.05 mol<sup>-1</sup> NaOH solution of diameter 1 cm and length 50 cm is 5.55 X 10<sup>3</sup> ohm. Calculate its resistivity, conductivity & molar conductivity.
41. State Kohlrausch law and its application. Limiting molar conductivity of NaCl, HCl and NaAc are 126.4, 425.9 & 91 S cm<sup>2</sup> mol<sup>-1</sup>. Calculate Limiting molar conductivity of HAc.
42. Define the term degree of dissociation. Write an expression that relates the molar conductivity of a weak electrolyte to its degree of dissociation.
43. Calculate the degree of dissociation of acetic at 298K, given that  $\Lambda_{m(\text{CH}_3\text{COOH})} = 11.7 \text{ S cm}^2 \text{ mol}^{-1}$ ,  $\Lambda_{m(\text{CH}_3\text{COO}^-)}^0 = 40.9 \text{ S cm}^2 \text{ mol}^{-1}$ ,  $\Lambda_{m(\text{H}^+)}^0 = 349.1 \text{ S cm}^2 \text{ mol}^{-1}$
44. Conductivity of 0.00241M acetic acid is 7.896 X 10<sup>-6</sup> S cm<sup>-1</sup>. Calculate its molar conductivity. If  $\Lambda^0$  for acetic acid is 390.5 S cm<sup>2</sup> mol<sup>-1</sup>. What is its dissociation constant?
45. Conductivity of 0.001028 M acetic acid is 4.95 X 10<sup>-5</sup> S cm<sup>-1</sup>. Calculate its molar conductivity. If  $\Lambda^0$  for acetic acid is 390.5 S cm<sup>2</sup> mol<sup>-1</sup>. What is its dissociation constant?
46. The molar Conductivity of 0.025 mol<sup>-1</sup> methanoic acid is 46.1 S cm<sup>2</sup> mol<sup>-1</sup>. Calculate its degree of dissociation & dissociation constant. If  $\lambda^0(\text{H}^+)$  is 349.6 S cm<sup>2</sup> mol<sup>-1</sup> and  $\lambda^0(\text{HCOO}^-) = 54.6 \text{ S cm}^2 \text{ mol}^{-1}$ .
47. How do you account for molar conductivity of strong and weak electrolyte with concentration? Plot the graphs also.
48. Why on dilution the  $\Lambda_m$  of CH<sub>3</sub>COOH increases drastically, while that of CH<sub>3</sub>COONa increases gradually?
49. Solutions of two electrolytes 'A' and 'B' are diluted. The  $\Lambda_m$  of 'B' increases 1.5 times while that of A increases 25 times. Which of the two is a strong electrolyte? Justify your answer.
50. In an aqueous solution how does specific conductivity of electrolytes change with addition of water?
51. Why does the conductivity of a solution decrease with dilution?

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52. Predict the products of electrolysis: (a) An aq. Solution of  $\text{AgNO}_3$  with silver electrodes. (b) An aq. Solution of  $\text{AgNO}_3$  with platinum electrodes. (c). An aq. Solution of  $\text{H}_2\text{SO}_4$  with platinum electrodes. (d). An aq. Solution of  $\text{CuCl}_2$  with platinum electrodes. (e) Aqueous sodium bromide (f) Copper sulphate using inert electrodes (Pt) (g) Molten  $\text{NaCl}$  (h) Aqueous sodium chloride solution
53. How will the pH of brine (aq.  $\text{NaCl}$  solution) be affected when it is electrolysed?
54. Following reactions occur at cathode during electrolysis of Aqueous solution of  $\text{AgCl}$  solution:  
(a)  $\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$   $E^0 = +0.80\text{V}$  (b)  $\text{H}^+(\text{aq}) + \text{e}^- \rightarrow \text{H}_2(\text{s})$   $E^0 = 0.00\text{V}$  on the basis of their standard electrode potential values which reaction is feasible at the cathode and why?
55. During electrolysis of Aqueous solution of  $\text{NaBr}$  solution there are two possible reactions  
(a)  $2\text{H}_2\text{O}(\text{l}) \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$   $E^0 = +1.23\text{V}$  (b)  $2\text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\text{s}) + 2\text{e}^-$   $E^0 = 1.08\text{V}$  on the basis of their standard electrode potential values which reaction is feasible at the anode and why?



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22. A reaction is first order in A and second order in B. Write differential rate equation.  
ii) How is the rate affected when concentration of B is tripled?  
iii) How is the rate affected when the concentration of both A and B is doubled?
23. A reaction is second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is (i) doubled (ii) reduced to half ?
24. For the reaction  $A \rightarrow B$  the rate becomes 27 times when the concentration of A is increased 3 times. What is the order of reaction?
25. For the reaction  $A \rightarrow B$ , the rate of reaction becomes three times when the concentration of A is increased nine times. What is the order of the reaction ?
26. The conversion of molecules x to y follows second order kinetics. If the concentration of x is increased to three times, how will it affect the rate of formation of y?
27. For the reaction  $2X \rightarrow X_2$ , the rate of reaction becomes three times when the concentration of X is increased 27 times. What is the order of the reaction ?
28. For the reaction  $A \rightarrow B$ , the rate of reaction becomes three times when the concentration of A is increased nine times. What is the order of the reaction ?
29. The decomposition of  $NH_3$  on platinum surface is zero order reaction. What are the rates of production of  $N_2$  and  $H_2$  if  $k = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ S}^{-1}$ ?
30. The decomposition of dimethyl ether leads to the formation of  $CH_4$ ,  $H_2$  and  $CO$  and the reaction rate is given by  $\text{Rate} = k [CH_3CHO]^{3/2}$ . The rate of reaction is followed by increase in pressure in a closed vessel, so the rate can also be expressed in terms of the partial pressure of dimethyl ether, i.e.,  $\text{Rate} = k (p_{CH_3CHO})^{3/2}$ . If the pressure is measured in bar and time in minutes, then what are the units of rate and rate constants?
31. Explain the term Molecularity with example.
32. Define Rate determining step, Elementary & Complex reactions
33. Distinguish between order of reaction & Molecularity.
34. For which type of reactions, order and molecularity have the same value?
35. For a reaction  $A + B \rightarrow \text{Products}$ , the rate law is —  $\text{Rate} = k [A][B]^{3/2}$
36. Can the reaction be an elementary reaction? Explain
37. For a zero order reaction will the molecularity be equal to zero? Explain.
38. Why can't molecularity of any reaction be equal to zero?
39. Why molecularity is applicable only for elementary reactions and order is applicable for elementary as well as complex reactions?
40. Why can we not determine the order of a reaction by taking into consideration the balanced chemical equation?
41. Mention the factors that affect the rate of a chemical reaction.
42. The possible mechanism for the reaction :  $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$  is  
(i)  $NO + O_2 \xrightleftharpoons{K} NO_3$  (fast)                      (ii)  $NO_3 + NO \xrightarrow{K_2} NO_2 + NO_2(g)$  (slow).  
Write the rate law for the reaction
43. For a reaction  $2H_2O_2 \xrightarrow{I^-, \text{Alkaline}} 2H_2O + O_2$  the proposed mechanism is as follows  
(i)  $H_2O_2 + I^- \rightarrow H_2O + IO^-$  (slow) (ii)  $H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$  (fast)  
(a) Write the rate law for the reaction.  
(b) Write the overall order of reaction.  
(iii) Out of steps (i) & (ii) which one is rate determining step.

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44. For a chemical reaction  $A + 2B \rightarrow 2C + D$ . The experimentally obtained information is given below.

Experiment	[A]₀	[B]₀	Initial rate
1	0.30	0.30	0.096
2	0.60	0.30	0.384
3	0.30	0.60	0.192
4	0.60	0.60	0.768

- Derive the order of reaction w.r.t. both the reactants A and B.
- Write the rate law.
- Calculate the value of rate constant k
- Write the expression for the rate of reaction in terms of A and C.

45. For a certain chemical reaction  $2A + B \rightarrow C + D$  The following result has been obtained:

Experiment	[A] mol L <sup>-1</sup>	[B] mol L <sup>-1</sup>	Initial rate mol L <sup>-1</sup> min <sup>-1</sup>
I	0.1	0.1	$6.0 \times 10^{-3}$
II	0.3	0.2	$7.2 \times 10^{-2}$
III	0.3	0.4	$2.88 \times 10^{-1}$
IV	0.4	0.1	$2.40 \times 10^{-2}$

Determine the rate law and rate constant for the reaction

19. The reaction between A and B is first order with respect to A and zero order with respect to B. Fill in the blanks in the following table:

Experiment	[A] mol L <sup>-1</sup>	[B] mol L <sup>-1</sup>	Initial rate mol L <sup>-1</sup> min <sup>-1</sup>
I	0.1	0.1	$2.0 \times 10^{-2}$
II	—	0.2	$4.0 \times 10^{-2}$
III	0.4	0.4	—
IV	—	0.2	$2.0 \times 10^{-2}$

20. In a reaction between A and B, the initial rate of reaction ( $r_0$ ) was measured for different initial concentrations of A and B as given below:

A/ mol L <sup>-1</sup>	0.20	0.20	0.40
B/ mol L <sup>-1</sup>	0.30	0.10	0.05
$r_0$ /mol L <sup>-1</sup> s <sup>-1</sup>	$5.07 \times 10^{-5}$	$5.07 \times 10^{-5}$	$1.43 \times 10^{-4}$

What is the order of the reaction with respect to A and B?

- Derive the Integrated rate equation for Zero order reaction. Find half life period and plot the graph associated to it.
- For a zero order chemical reaction: (a) Plot variation in the concentration in [R] vs. time (b) what are the units of rate constant k? (c) give the relationship between k and  $t_{1/2}$  (half life period) (d) Give the slope
- A substance with initial concentration 'a' follow zero order kinetics with rate constant 'k' mol L<sup>-1</sup> s<sup>-1</sup>. In how much time will the reaction go to completion?
- The rate constant for a reaction of zero order reaction in A is  $0.0030 \text{ mol L}^{-1} \text{ s}^{-1}$ . How long will it take for the initial concentration of A to fall from 0.10 M to 0.075M?
- The decomposition of NH<sub>3</sub> on platinum surface is zero order reaction. If rate constant is  $4 \times 10^{-3} \text{ Ms}^{-1}$ , how long will it take to reduce the initial concentration of NH<sub>3</sub> from 0.1M to 0.064M.

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26. Derive the Integrated rate equation for first order reaction. Find half life period and plot the graph associated to it.
27. For a first order chemical reaction:
  - (i) Plot variation in the concentration in  $\ln[R]$  vs. time & Give the slope (s)
  - (ii) Draw the plot  $\log [R]_0 / [R]$  vs. time  $t(s)$  & Give the slope
  - (iii) what are the units of rate constant  $k$ ?
  - (iv) give the relationship between  $k$  and  $t_{1/2}$  (half life period) (iv) Give the slope
28. For a reaction  $R \rightarrow P$  half-life period is independent of initial concentration of the reacting species. What is the order of reaction.
29. (a) Define half life period of a reaction .(b) Write the expressions of half life for (i) first order chemical reaction (ii) zero order chemical reaction
30. What are pseudo first order reactions? Give one example of such reaction.
31. A first order reaction has rate constant  $1.15 \times 10^{-3} \text{ s}^{-1}$ . How long will 5 g of this reactant take to reduce to 3 g?
32. Time required to decompose  $\text{SO}_2\text{Cl}_2$  to half of its initial amount is 60 minutes. If the decomposition is a first order reaction, calculate the rate constant of the reaction.
33. The initial concentration of  $\text{N}_2\text{O}_5$  in the following first order reaction  $\text{N}_2\text{O}_5(\text{g}) \rightarrow \text{NO}_2(\text{g}) + 1/2\text{O}_2(\text{g})$  was  $1.24 \times 10^{-2} \text{ mol L}^{-1}$  at 318 K. The concentration of  $\text{N}_2\text{O}_5$  after 60 minutes was  $0.20 \times 10^{-2} \text{ mol L}^{-1}$ . Calculate the rate constant of the reaction at 318 K.
34. A first order reaction is found to have a rate constant.  $k = 5.5 \times 10^{-4} \text{ s}^{-1}$ . Find the half-life of the reaction.
35. Show that in a first order reaction, time required for completion of 99.9% is 10 times of half-life ( $t_{1/2}$ ) of the reaction.
36. For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction.
37. Calculate the half-life of a first order reaction from their rate constants given :
  - (i)  $200 \text{ s}^{-1}$  (ii)  $2 \text{ min}^{-1}$  (iii)  $4 \text{ years}^{-1}$ .
38. The half-life for radioactive decay of  $^{14}\text{C}$  is 5730 years. An archaeological artifact containing wood had only 80% of the  $^{14}\text{C}$  found in a living tree. Estimate the age of the sample
39. The rate constant for a first order reaction is  $60 \text{ s}^{-1}$ . How much time will it take to reduce the initial concentration of the reactant to its  $1/16^{\text{th}}$  value?
40. During nuclear explosion, one of the products is  $^{90}\text{Sr}$  with half-life of 28.1 years. If  $1 \mu\text{g}$  of  $^{90}\text{Sr}$  was absorbed in the bones of a newly born baby instead of calcium, how much of it will remain after 10 years and 60 years if it is not lost metabolically.
41.  $\text{H}_2\text{O}_2$  decomposes to  $\text{H}_2\text{O}$  and  $\text{O}_2$  in a reaction that is first order and has rate constant  $k = 1.06 \times 10^{-3} \text{ min}^{-1}$ . How long will it take 15% of a sample of  $\text{H}_2\text{O}_2$  to decompose.
42. A first order reaction takes 30 minutes for 50% decomposition. Calculate the time required for 90% completion for this reaction
43. A first order reaction takes 100 minutes for 60% decomposition. Calculate the time required for 90% completion for this reaction
44. A first order reaction takes 20 minutes for 25% decomposition. Calculate the time required for 75% completion for this reaction
45. A first order reaction takes 40 min for 30% decomposition. Calculate  $t_{1/2}$ .
46. Consider a certain reaction  $A \rightarrow \text{Products}$  with  $k = 2.0 \times 10^{-2} \text{ s}^{-1}$ . Calculate the concentration of A remaining after 100 s if the initial concentration of A is  $1.0 \text{ mol L}^{-1}$ .

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47. Sucrose decomposes in acid solution into glucose and fructose according to the first order rate law, with  $t_{1/2} = 3.00$  hours. What fraction of sample of sucrose remains after 8 hours?
48. A first order reaction has a rate constant  $0.0051 \text{ min}^{-1}$ . If we begin with  $0.10 \text{ M}$  concentration of the reactant, what concentration of the reactant will be left after 3 hours. The
49. A reactant has a half life of 10 min.  
 (i) Calculate the rate constant for the first order reaction  
 (ii) what fraction of the reactant will be left after an hour of the reaction has occurred.
50. The decomposition of phosphine  $\text{PH}_3$  proceeds according to the following equation:  
 $4\text{PH}_3 \rightarrow \text{P}_4 + 6\text{H}_2$ , It is found that the reaction follows rate reaction rate  $= k[\text{PH}_3]$ . The half life of  $\text{PH}_3$  is 37.9 second at  $120^\circ\text{C}$ .  
 (i) How much time is required for  $3/4^{\text{th}}$  of  $\text{PH}_3$  to decompose?  
 (ii) What fraction of the original sample of  $\text{PH}_3$  remains behind after 1 minute?
51. For a first order reaction, time taken for half of the reaction to complete is  $t_1$ , whereas that for  $3/4^{\text{th}}$  of the reaction to complete is  $t_2$ . How are  $t_1$  and  $t_2$  related?
52. For the decomposition of azoisopropane to hexane and nitrogen at  $543\text{K}$ , the following data were obtained. Calculate the rate constant.

t (sec)	P(mm of Hg)
0	35.0
360	54.0
720	63.0

53. The Following data were obtained during the first order thermal decomposition of  $\text{SO}_2\text{Cl}_2$  at a constant volume:  $\text{SO}_2\text{Cl}_2(\text{g}) \rightarrow \text{SO}_2(\text{g}) + \text{Cl}_2(\text{g})$ . Calculate the rate constant.

Experiment	Time	Pressure (atm)
1	0	0.4
2	100	0.7

54. The following data were obtained during the first order thermal decomposition of  $\text{N}_2\text{O}_5$  (g) at constant volume:  $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 2\text{N}_2\text{O}_4(\text{g}) + \text{O}_2(\text{g})$ . Calculate the rate constant.

S.No	Time	Pressure (atm)
1	0	0.5
2	100	0.512

55. Following data were obtained for the reaction :  $\text{N}_2\text{O}_5(\text{g}) \rightarrow 2\text{NO}_2(\text{g}) + 1/2 \text{O}_2(\text{g})$ .

Time (s)	0	300	600
$[\text{N}_2\text{O}_5(\text{g})]$ (mol/l)	$1.6 \times 10^{-2}$	$0.8 \times 10^{-2}$	$0.4 \times 10^{-2}$

- (i) Show that it follows first order reaction  
 (ii) Calculate the half life
56. In a pseudo first order hydrolysis of ester in water, the following results were obtained:

Time (s)	0	30	60	90
[Ester] (mol/l)	0.55	0.31	0.17	0.085

- (i) Calculate the average rate of reaction between the time interval 30 to 60 seconds. (ii) Calculate the pseudo first order rate constant for the hydrolysis of ester

## **UNIT: 5:- SURFACE CHEMISTRY**

1. Distinguish between the meaning of the terms adsorption and absorption. Give one example of each.
2. Define the terms desorption & Sorption.
3. What is the difference between Physisorption and Chemisorption?
4. What is the sign of  $\Delta H$  &  $\Delta S$  when a gas is adsorbed by an adsorbent.
5. Explain the reason for following :
  - a) Powdered substances more effective adsorbents than their crystalline forms.
  - b) Finely divided substance is more effective as an adsorbent.
  - c)  $\text{NH}_3$  gas adsorbs more readily than  $\text{N}_2$  gas on the surface of Charcoal.
  - d) Adsorption is accompanied by decrease in entropy.
  - e) Enthalpy of chemisorption is high .
  - f) Adsorption is always exothermic.
  - g) Physical adsorption is reversible , while chemisorption is irreversible
  - h) Physisorption decrease with the increase of temperature.
  - i) Physical adsorption is multilayered, while chemisorption is monolayered.
  - j) It is important to have clean surface in surface studies.
  - k) We add alum to purify water.
  - l) Adsorption of a gas on the surface of solid is generally accompanied by a decrease in entropy. Still it is spontaneous process.
  - m) White precipitate of silver halide become coloured in the presence of dye eosin.
6. Discuss the effect of pressure and temperature on the adsorption of gases on solids.(  
Hint:Effect of Temperature and Pressure: The adsorption of gases on solids decreases with increase in temperature at constant pressure Effect of Pressure: The adsorption of gases on solids Increases with increase in pressure at constant Temperature.)
7. Out of  $\text{NH}_3$  &  $\text{CO}_2$  which gas will be adsorbed more readily on the surface of activated Charcoal & why?
8. Arrange  $\text{H}_2$ ,  $\text{CH}_4$ ,  $\text{CO}_2$  and  $\text{NH}_3$  in order of the ease with which the gases are adsorbed on the surface of charcoal.
9. What do you understand by activation of adsorbent? How is it achieved?
10. Why is chemisorption referred to as activated adsorption?
11. What is the effect of temperature on chemisorptions.
12. Explain Adsorption from solution phase.
13. Give applications of adsorption
14. Explain clearly how the phenomenon of adsorption finds application in : (a) Production of high vacuum (b) (c) Froth floatation process (d)Controlling humidity.
15. Why do physisorption and chemisorption behave differently with rise in temperature?
16. What is the role of activated charcoal in gas mask used in coal mines?
17. Give an example where physisorption changes to chemisorption with rise in temperature. Explain the reason for change.
18. What are the factors which influence the adsorption of a gas on a solid? (Hint: (i)Nature of adsorbate (ii) Surface area of adsorbent (iii) Temperature (iv) Pressure)
19. What is an adsorption isotherm?
20. Describe Freundlich adsorption isotherm.
21. Differentiate among a True solution , a suspension and a Colloidal solution give a suitable example of each.



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22. How are colloids classified on the basis of (i) Physical states of components (ii) Nature of dispersion medium and (iii) Interaction between dispersed phase and dispersion medium.
23. Write the Dispersed Phase & Dispersion Medium of the following Colloidal Solutions.  
(a) Smoke (b) Butter (c) Milk (d) Fog (e) Froth (f) dust
24. What type of colloid is formed when (a) Liquid is dispersed in a solid. (b) Gas is dispersed in a liquid. (c) solid is dispersed in a Gas. (d) Liquid is dispersed in a liquid (e) solid is dispersed in a liquid. Give Examples for each case.
25. What are the physical states of dispersed phase and dispersion medium of froth?
26. Explain the terms with suitable examples : (i) Alcosol (ii) Aerosol (iii) Hydrosol.
27. What are Lyophilic and Lyophobic sols? Give one example of each type.
28. Why hydrophobic sols are easily coagulated?
29. What is difference between multimolecular and macromolecular colloids? Give one example of each.
30. Define associated colloids giving an example.
31. Define the terms : (i) Critical Micelle concentration (CMC) (ii) Kraft Temperature ( $T_K$ ) (iii) ionic micelle'
32. What type of solutions are formed on dissolving different concentrations of soap in water?
33. What are micelles? Give an example of a micellers system.
34. Write chemical methods of preparation of colloids.
35. How are following colloidal solutions prepared? (i) Sulphur in water (ii) Gold in water
36. Write physical methods Preparation of Colloids.
37. Write a note on: (i) Bredig's Arc methods (b) Peptization
38. Explain the following with diagrams: (a) Dialysis (b) Electro-dialysis (c) ultrafiltration
39. Explain the following terms (a) Tyndall effect (b) Brownian movement (c) Electrophoresis. (d) Hardy Schulze rule. (e) Zeta Potential
40. What is the reason for Brownian movement in colloidal solution.
41. Explain Coagulation. Describe any three methods by which coagulation of lyophobic sols can be carried out.
42. How can a colloidal solution and true solution of the same colour be distinguished from each other.
43. What happens when electric field is applied to colloidal solution?
44. On the basis of Hardy-Schulze rule explain why the coagulating power of phosphate is higher than chloride.
45. Most effective electrolyte causing the coagulation of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O} / \text{Fe}^{3+}$  is a)  $\text{MgCl}_2$  b)  $\text{KCl}$  c)  $\text{K}_4[\text{Fe}(\text{CN})_4]$  d)  $\text{AlCl}_3$
46. Which one of the following electrolytes is most effective for the Coagulation of  $\text{Fe}(\text{OH})_3$  sol & why . (a)  $\text{NaCl}$  (b)  $\text{Na}_2\text{SO}_4$  (c)  $\text{Na}_3\text{PO}_4$
47. Out of  $\text{BaCl}_2$  &  $\text{KCl}$  which one is more most effective for the Coagulation of negatively charged sol & why .
48. A colloidal solution of  $\text{AgI}$  is prepared by two different methods. (A)  $\text{AgNO}_3$  solution is added to excess  $\text{KI}$  solution. (B)  $\text{KI}$  solution is added to excess  $\text{AgNO}_3$  solution. What is the charge on the  $\text{AgI}$  colloidal particles in the two cases. Explain.
49. Why is  $\text{Fe}(\text{OH})_3$  colloid positively charged, when prepared by adding  $\text{FeCl}_3$  to hot water?

***Based On Revised Syllabus FOR CBSE 2021 EXAMS***

50. How does it become possible to cause artificial rain by spraying silver iodide on the clouds?
51. What happens when gelatin is mixed with gold sol?
52. How does the precipitation of colloidal smoke take place in Cottrell precipitator?
53. What is the reason for stability of colloidal solution.
54. Give reason for the following :
- (a) Leather gets hardened after Tanning.
  - (b) Delta is formed at the meeting point of sea water and river water.
  - (c) Bleeding stop by rubbing moist alum.
  - (d) some medicines more effective in the colloidal form
  - (e) Sky looks blue to us.
  - (f) ferric chloride preferred over potassium chloride in case of a cut Leading to bleeding
  - (g) Lyophilic sols are more stable than lyophobic sols
  - (h) Lyophilic sols are also called as reversible sols.
  - (i) Artificial Rain is caused by spraying salt over clouds.
  - (j) Gelatin which is a peptide is added in icecreams
  - (k) Same substance can act as both colloids & crystalloids.
55. Explain what is observed:
- (i) When a beam of light is passed through a colloidal sol.
  - (ii) An electrolyte, NaCl is added to hydrated ferric oxide sol or ferric hydroxide.
  - (iii) Electric current is passed through a colloidal sol.
  - (iv) Ferric hydroxide sol gets coagulated on addition of sodium chloride solution
  - (v) Cottrell's smoke precipitator is fitted at the mouth of the chimney used in factories.
  - (vi) Persistent dialysis of a colloidal solution is carried out.