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12

CHEMISTRY

WORKSHEETS AND ASSIGNMENTS

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Contents

1 SOLID STATE

1. What is meant by forbidden zone in reference to band theory of solids?(2012)

2. 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?

3. Write the formula of a compound in which the element Y forms *ccp* lattice and atoms of X occupies $1/3^{rd}$ of tetrahedral voids. (2015)

4. An alloy of gold and cadmium crystallizes with a cubic structure in which gold atoms occupies the corners and cadmium atoms fit into the face center. Assign formula of this alloy. (2011)

5. Iron has a bcc unit cell with a cell dimension of 286.65pm. The density of Fe is 7.874 gcm^{-3}. Use this information to calculate Avogadro's number. (Fe = 55.845u) (2012)

6. Silver crystallizes in fcc unit cell. If the edge length of Ag atom is 4.07×10^{-8} cm and density of silver is 10.5 g cm^{-3} calculate the atomic mass of silver. (2010)

7. An element crystallizes in fcc structure with edge length 200pm. Calculate the density if 200g of the element contains 24×10^{23} atoms.

8. How are the following properties of crystal affected by Schottky and Frenkel defect:
   a) Density
   b) Electrical conductivity (2010)

9. a) Why does the presence of excess of lithium make LiCl crystals pink?
   b) Calculate the number of atoms in cube based unit cell having one atom on each corner and two atoms on its each body diagonal. (2013)

10. Account for the following: (2007)
    a) Phosphorus doped with silicon is a semi-conductor.
    b) Schottky defect lowers the density of the solid.
    c) Some of the very old glass objects appear slightly milky instead of being transparent.

11. Explain the following properties giving suitable examples:
    a) Ferromagnetism
    b) Para magnetism
    c) Ferrimagnetism

12. An element A crystallizes in fcc structure. 208g of it have 4.28×10^{24} atoms. Calculate the edge length if the density is 7.2g/cc.

13. An element crystallizes in cubic structure. The edge length of the unit cell is 350pm. If its molar mass is 6.94g/mole, and the density 0.534g/cc, how many atoms are present in one unit cell of the element?

14. Define the following :
    a) Schottky defect
    b) Frenkel defect
    c) F-centre (2015)

15. Differentiate between:
    a) Face centered and end centered unit cells
    b) Ferromagnetic and ferrimagnetic substances
    c) n-type and p-type semiconductors
    d) Tetragonal and orthorhombic unit cells
    e) Crystal lattice and unit cell

16. Niobium crystallizes in bcc structure. If the density is 8.55g/cc, calculate the atomic radius of Nb. [93]
17. Gold crystallizes in fcc arrangement. Calculate the radius of gold atom is its edge length is 40.2nm.
18. If NaCl is doped with 10^{-3} mole % of $SrCl_2$, what is the concentration of cation vacancies?
19. An element exists in bcc lattice with edge length 288pm. If its density is 7.3g/cc, how many atoms are present in 208 g of the same?
20. Gold crystallizes in fcc lattice. What is the density of gold if the radius of gold atom is 236pm. RAM = 197.
21. Silver crystallizes in fcc lattice. If the edge length of unit cell is 4.077×10^{-8} cm and the density is 10.05g/cc, calculate the atomic mass of Ag.
22. Calculate the efficiency in packing in a) simple cube b) fcc c) bcc
23. Iron has a body centred cubic unit cell with cell edge of 286.65pm. The density of iron is $7.87 gcm^{-3}$. Use this information to calculate Avogadro's number. (Atomic mass of Fe = 56 g mol^{-1})

2 SOLUTIONS

1. Why do gases always tend to be less soluble in liquids as the temperature is raised?
2. 'The osmotic pressure measured when benzoic acid is dissolved in benzene is less than the expected value'. Comment.
3. Which is the best colligative property to measure the molar masses of macro molecules? Why?
4. 18 g of glucose, $C_6H_{12}O_6$ (molar mass = 180 g mol^{-1}) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil?
   (K_b for water = 0.52 k kg mol^{-1}, boiling point of pure water = 373.15 K) (2013)
5. Define an ideal solution and write one of its characteristics. (2014)
6. Compare solubility of oxygen gas at 293K (K_H =35kbar) & at 393K (K_H =47kbar)
7. What are azeotropic mixtures? What are its types?
8. a) Why are aquatic species more comfortable in cold water than in warm water?
   b) What happens when we place the blood cell in saline water solution (hypertonic solution)? Give reason. (2015)
9. Calculate the amount of KCl which must be added to 1 kg of water so that the freezing point is depressed by 2K. (K_f for water = 1.86 kg mol^{-1}) (2012)
10. Determine the osmotic pressure of a solution prepared by dissolving 2.5 x 10^{-2} g of K_2SO_4 in 2L of water at 25^0C, assuming that it is completely dissociated.
    (R = 0.0821 L atm $K^{-1}mol^{-1}$, molar mass of K_2SO_4 = 174 g mol^{-1}) (2013)
11. A solution of glucose in water is labelled as 10% w/w, what would be the molality and mole fraction of each component in the solution? If the density of solution is 1.2 g mL^{-1}, then what shall be the molarity of the solution?
12. A solution containing 30 g of non-volatile solute exactly in 90 g of water has a vapour pressure of 2.8 kPa at 298 *K*. Further, 18 g of water is then added to the solution and the new vapour pressure becomes 2.9 kPa at 298 *K*. Calculate: (i) Molar mass of the solute (ii) Vapour pressure of water at 298 *K*.
13. Calculate the depression in the freezing point of water when 10 g of $CH_3CH_2CHClCOOH$ is added to 250 g of water. $K_a = 1.4 \times 10^{-3}$, $K_f = 1.86$ K kg mol^{-1}.
14. Two elements A and B form compounds having formula AB_2 and AB_4. When dissolved in 20 g of benzene (C_6H_6), 1 g of AB_2 lowers the freezing point by 2.3 *K* whereas 1.0 g of AB_4 lowers it by 1.3 *K*. The molar depression constant for benzene is 5.1 *K* kg mol^{-1}. Calculate atomic masses of A and B.

15. Vapour pressure of water at 20°C is 17.5 mm Hg. Calculate the vapour pressure of water at 20° C when 15 g of glucose (Molar mass = 180 g mol^{-1}) is dissolved in 150 g of water. (2015)

16. a) Explain the following:
    i. Henry's law about dissolution of a gas in a liquid.
    ii. Boiling point elevation constant for a solvent.
    b) A solution of glycerol ($C_3H_8O_3$) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100.42°C. What mass of glycerol was dissolved to make this solution? (K_b for water = 0.512 K kg mol^{-1}) (2012)

17. a) On mixing acetone with chloroform, a reduction occurs in total volume. What type of deviations from ideal behavior for solutions is shown in this case and why?
    b) Phenol associates in benzene to certain extent to form a dimer. A solution containing 20 g of phenol in 1.0 kg of benzene has its freezing point lowered by 0.69 K. Calculate the fraction of phenol that has dimerised. Given Kf for benzene = 5.1 K m^{-1}(2011)

18. a) What is van't Hoff factor? What types of values can it have if in forming the solution the solute molecules undergo
    i) Dissociation
    ii) Association
    b) How many mL of a 0.1 M HCl solution are required to react completely with 1g of a mixture of Na_2CO_3 and $NaHCO_3$ containing equimolar amounts of both ?

19. Define the term osmotic pressure. Describe how the molecular mass of a substance can be determined by a method based on measurement of osmotic pressure. (2008)

20. 5 g of a solute of molecular mass 60 is dissolved in 100g of water.The depression in freezing point is 2K.Calculate degree of dissociation if m= 2

21. A 0.1m solution of H_3PO_4 in water is observed to freeze at 0.24C. Determine the degree of dissociation in the acid in the solution.

22. An aqueous solution containing 0.1gm a monobasic acid in 2.17 gm of water freezes at 272.817 K. Calculate the molar mass of the acid if kf = 1.86 K Kg/mole

23. What is the i for the following solutions a] $MgBr_2$ b] $[K_4Fe(CN)_6]$ c] $AlCl_3$

24. Calculate the i value of a 0.5M acetic acid solution which is 35% dissociated.

25. A decimolar$K_4[Fe(CN)_6]$ is 50% dissociated. Calculate the osmotic pressure at 298K.

26. A solution containing 2 gm of a non-volatile solute in 20 gm of water boils at 373.52 K. Find the molecular mass of the solute if kb for water is 0.52 K Kg/mole.

27. Calculate the elevation in Boiling point when 18 gm of glucose is added to 100 gm of water if kb for water is 0.52 K Kg/mole

28. 34.2 gm of sucrose is dissolved in 1000 gm of water. Find the freezing point of the solution if kf for water is 1.86 K Kg/mole.

29. The normal freezing point of nitrobenzene is 278.82 K. A 0.25 molal solution containing a non-volatile solute in it causes a depression in freezing point by 2 deg. Calculate the cryoscopic constant of nitrobenzene.

3 ELECTROCHEMISTRY

1. What is meant by limiting molar conductivity? (2010)

2. The E° values of Cu and Zn are 0.34V and – 0.76V respectively. Which of the two is a stronger reducing agent?

3. How many faradays are required to produce 2.4g of Mg?

4. How much charge is needed to oxidize one mole of FeO to Fe_2O_3?

5. Define and express the relationship between conductivity and molar conductivity for the solution of an electrolyte. (2011)

6. Electrolytic specific conductance of 0.25M solution of KCl at 25^0C is 2.56 x 10^{-2}S/cm, calculate the molar conductance.

7. Describe the reactions which occur at the electrodes in a fuel cell that causes H_2 and O_2 to produce electricity.

8. How many hours does it take to reduce 3 moles of Fe^{3+} to Fe^{2+} with a current of 2amps?

9. Account for the following:
   a) Alkaline medium inhibits the rusting of iron.
   b) Iron does not rust even if the zinc coating is broken in a galvanized iron pipe.

10. Calculate the time to deposit 1.5 g of silver at cathode when a current of 1.5 A was passed through the solution of $AgNO_3$. (Molar mass of Ag = 108 g mol^{-1}, 1 F = 96500 C mol^{-1}) (2015)

11. Three electrolytic cells A, B, C containing solutions of $ZnSO_4$, $AgNO_3$ and $CuSO_4$, respectively are connected in series. A steady current of 1.5 amperes was passed through them until 1.45 g of silver deposited at the cathode of cell B. How long did the current flow? What mass of copper and zinc were deposited? (2008)

12. Conductivity of 0.00241 M acetic acid is 7.896×10^{-5} S cm^{-1}. Calculate its molar conductivity and if λ^0_m for acetic acid is 390.5Scm^2 mol^{-1}, what is its dissociation constant?

    (2008)

13. Calculate the equilibrium constant and ΔG^0 for the following reaction at 25^0C.
    $Ni(s) + 2Ag^+(aq) \rightarrow Ni^{2+}(aq) + 2Ag(s)$,
    Given that the cell potential at 25^0C is 1.05V. (1F = 96500 C mol^{-1}) (2011)

14. What type of a battery is the lead storage battery? Write the anode and cathode reactions and the overall reaction occurring in a lead storage battery when the cell is in use. (2011)

15. A conductivity cell with cell constant $3cm^{-1}$ is filled with 0.1M acetic acid solution. The resistance is found to be 4000 ohms. Find a] molar conductance of 0.1M acetic acid
b] Degree of dissociation of acetic acid given that $\Lambda^0 (CH_3COOH) = 400\ S\ cm^2\ mol^{-1}$.

16. a) State Kohlrausch law of independent migration of ions. Write an expression for the molar conductivity of acetic acid at infinite dilution according to Kohlrausch law.
b) Calculate λ^0_m for acetic acid.
Given that $\lambda^0_m (HCl) = 426\ Scm^2mol^{-1}$ and
$\lambda^0_m (CH_3COONa) = 91\ Scm^2mol^{-1}$ (2010)

17. What is an electrochemical series? How does it predict the feasibility of acertaii redox reaction?

18. How is standard electrode potential of a cell related to :-
i) Equilibrium constant?
ii) Gibbs free energy change.

19. The conductivity of an aqueous solution of NaCl in a cell is $92\ \Omega^{-1}\ cm^{-1}$ theresistance offered by this cell is 247.8Ω. Calculate the cell constant?

20. The molar conductivity of 0.1M CH_3COOH solution is $4.6\ cm^2\ mol^{-1}$.What is the conductivity and resistivity of the solution?

21. The conductivity of metals decreases while that of electrolytes increaseswith increases in temperature. Why?

22. The measured resistance of a cell containing 7.5×10^{-3} M solution of KCl at

25^0C was 1005 Ω calculate,

(a) Specific conductance and

(b) Molar conductance of the solution. Cell Constant = $1.25\ cm^{-1}$

23. How is Limiting molar conductivity related to
i) degree of ionization and ii) dissociation constant

24. State Faraday's Laws of electrolysis?

25. How many gram of chlorine can be produced by the electrolysis of molten NaCl with a current of 1 amp for 15 min?

26. How many electrons flow when a current of 5 amps is passed through a solution for

193 sec. Given F = 96500 C. $N_A = 6.002 \times 10^{23}\ mol^{-1}$?

27. Silver is deposited on a metallic vessel by passing a current of 0.2 amps for 3 hrs. Calculate the weight of silver deposited. (At mass of silver = 108 amu, F = 96500 C?

4 CHEMICAL KINETICS

1. Why does the rate of a reaction not remain constant throughout the reaction process? (2010)

2. The rate of a reaction is 1.2×10^{-3} L/mol/s. What is the order of the reaction?

3. Define the following terms :
   a) Half-life of a reaction ($t_{½}$)
   b) Rate constant (k) (2015)

4. A first order decomposition reaction takes 40 minutes for 30% decomposition. Calculate its $t_{1/2}$ value. (2008)

5. Show that for a first order reaction, the time required for half the change is independent of initial concentration. (2010)

6. A reaction is first order in A and second order in B.
   a) Write differential rate equation.
   b) How is the rate affected when the concentration of A is tripled?
   How is the rate affected when the concentration of both A and B are doubled?

7. An artifact containing wood has only 80% of the C^{14} activity found in a living tree. Estimate the age of the artifact if $t_{1/2}$ of C^{14} is 5730 years.

8. The time required for 10% completion of a first order reaction at 298 K is equal to that required for its 25% completion at 308K.if the value of A is 4×10^{10}/s, calculate k at 318K and E_a

9. (a) For a reaction $A + B \rightarrow P$, the rate is given by

   Rate = $k[A]^2[B]$

   (i) How is the rate of reaction affected if the concentration of A is doubled?
   (ii) What is the overall order of reaction if B is present in large excess?

   (b) A first order reaction takes 23.1 minutes for 50% completion. Calculate the time required for 75% completion of this reaction.
   (Given : log 2 = 0.301, log 3 = 0.4771, log 4 = 0.6021)

10. A reaction is second order with respect to a reactant A. How is the rate of this reac altered if the concentration of A is

    i. Doubled
    ii. Reduced to half?

11. $H_2O_{2\,(aq)}$ decomposes to $H_2O_{(l)}$ and $O_{2\,(g)}$ in a reaction that is of first order in H_2O_2 and has a rate constant $K=1.06 \times 10^{-3}$ min^{-1}

    a) How long will it take 15% of a sample of H_2O_2 to decompose?
    b) How long will it take 85% of a sample of H_2O_2 to decompose?

12. The decomposition of PH_3 proceeds according to the following equation.

$4PH_{3(g)} \rightarrow P_{4(g)} + 6\ H_{2(g)}$

It is found that the reaction follows the following rate equation, Rate =k $[PH_3]$.The half life of PH_3 is 37.9 s at 120°C.

i. How much time is required for ¾ th of PH_3 to decompose?
ii. What fraction of the original sample of PH_3 remains behind after 1 minute?

13. Express the rate of reaction in terms of disappearance of hydrogen and appearance of ammonia in the given reaction. $N_2(g) + 3\ H_2(g) \rightarrow 2NH_3(g)$

14. Show that for a first order reaction,the time required for half life is independent of initial concentration.

15. A reactant has a half life of 10 minutes.
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?

16. Calculate the rate constant of a reaction at 293 K, given that:

E_a=103 KJ/Mol, k=7.87x $10^{-7}s^{-1}$, at 273 K,R=8.314 $JK^{-1}mol^{-1}$

17. For a decomposition reaction, the values of rate constant k , at two different temperatures are given below.

K_1=2.15x$10^{-8}Lmol^{-1}s^{-1}$ at 650 K , K_2=2.39 x$10^{-7}Lmol^{-1}s^{-1}$ at 700 K

Calculate the value of activation energy for this reaction R=8.314$JK^{-1}mol^{-1}$

18. A first order reaction takes 40 minutes for 30% decomposition. Calculate its $t_{1/2}$ value.

5 SURFACE CHEMISTRY

1. What is the basic difference between adsorption and absorption? (2010)
2. Why are finely divided substances more effective as an adsorbent? (2011)
3. Why is the adsorption phenomenon always exothermic? (2012)
4. What is meant by shape selective catalysis?
5. Out of $AlCl_3$ and NaCl, which is more effective in causing coagulation of a negative sol and why? (2015)
6. What is the difference between a colloidal solution and emulsion? What is the role of emulsifier in forming emulsion? (2010)
7. What are the characteristics of a solid catalyst?
8. What is activation of an adsorbent? How can it be achieved?
9. Differentiate between giving examples.
   a) Homogeneous and heterogeneous catalysis
   b) Physical and chemical adsorption
   c) Lyophobic and lyophilic colloids
10. What is the difference between multimolecular and macromolecular colloids? Give one example of each type. How associated colloids are different from these two types of colloids. (2010)
11. Explain how the phenomenon of adsorption finds application in each of the following processes:
    a) Production of vacuum
    b) Heterogeneous catalysis
    c) Froth floatation process (2011)
12. Explain the following terms:
    a) Tyndall effect
    b) Electrophoresis
    c) Dialysis (2011)
13. What happens when (2007)

    Electric current is passed through a colloidal solution.

    Solution of NaCl is added to a colloidal solution of $Fe(OH)_3$.

    An emulsion is subjected to centrifugation.
14. Define adsorption with an example. Why is adsorption exothermic in nature? Write the types of adsorption based on the nature of forces between adsorbate and adsorbent. (2015)

6 METALLURGY

1. Out of C and CO, which is a better reducing agent at 673 K? (2013)

2. Describe the role of
   a) Iodine in the refining of titanium. (2010)
   b) Collector in the froth floatation process. (2012)

3. Describe how the following changes are brought out:
   a) Pig iron into steel
   b) Zinc oxide into zinc metal. (2010)

4. Differentiate between
   a) Calcination and roasting
   b) Electrolytic reduction and electrolytic refining
   c) Flux and slag

5. Write the chemical reactions which take place in the following operations:
   a) Electrolytic reduction of Al_2O_3.
   b) Isolation of Zn from zinc blende.
   c) Mond's process for refining of Ni.

6. Give reasons:
   a) Copper matte is put in silica lined convertor.
   b) Cryolite is added to alumina during electrolytic reduction.
   c) Pine oil is used in the froth floatation process

7. a) Name the method used for the refining of titanium.
   b) What is the role of Zn in the extraction of silver?
   c) Reduction of metal oxide to metal becomes easier if the metal obtained is in liquid state. Why? (2015)

8. Write the reaction involved in the extraction of copper from low grade ores

9. The graphite electrodes in the extraction of 'alluminium' by Hall-Heroult process need to be changed frequently. Why?

10. Mention the role of following : (Each question carries one mark)
    i. SiO_2 in the extraction of Cu from copper matte.
    ii. $CaCO_3$ in the metallurgy of Fe.
    iii. CO in the metallurgy of iron .
    iv. I_2 in the purification of zirconium.
    v. NaCN in the extraction of gold from gold ore.
    vi. Cryolite in the metallurgy of Al

11. i. How is chemical reduction different from electrolytic reduction?
    ii. Name a metal each is obtained by
    (a) electrolytic reduction
    (b) chemical reduction.

12. Write the Chemical reactions taking place in different zones in the blast furnace for the extraction of iron from its ore.

13. Give equations for the industrial extraction of zinc from calamine.

14. Gibbs energies of formation $\Delta_f G$ of MgO(s) and CO(g) at 1273K and 2273 K are given below:

    $\Delta_f G$ [MgO(s)] = –941 kJ mol^{-1} at 1273 K.

    $\Delta_f G$ [CO(g)] = –439 kJ mol^{-1} at 1273 K.

    $\Delta_f G$ [MgO(s)] = –314 kJ mol^{-1} at 2273 K. $\Delta_f G$ [CO(g)] = –628 kJ mol^{-1} at 2273 K.

    On the basis of above data, predict the temperature at which carbon can be used as a reducing agent for MgO(s).

15. The choice of a reducing agent in a particular case depends on thermodynamic factor. How far do you agree with this statement? Support your opinion with two examples.

16. i. Name the principal ore of Aluminium.
    ii. Write the equation for the reactions taking place at the anode and the cathode during the extraction of aluminium by the electrolytic process

17. i. Write thename or formula of any two sulphide ores of copper.
    ii. Explain the froth floatation process

18. Describe how the following changesare brought about

    i. Pig iron into steel
    ii. Zinc Oxide into metallic zinc
    iii. Impure titanium into pure titanium

19. Describe the principle behind each of the following processes

    i. Vapour phase refining of a metal
    ii. Electrolytic refining of a metal
    iii. Recovery of silver after silver ore was leached with NaCN.

20. State the principles of the following methods of refining crude metals

    i. Zone refining
    ii. Liquation method
    iii. Chromatographic method.

7 P-Block Elements

1. Why does NO_2 dimerise? (2010)
2. Fluorine does not exhibit any positive oxidation state. Why? (2010)
3. What happens when H_3PO_3 is heated?
4. Name a compound in which chlorine displays '+7' oxidation number.
5. On heating Cu turnings with conc. HNO_3, a brown coloured gas is evolved which on cooling dimerises. Identify the gas. (2016)
6. Explain why
   a) Noble gases form compounds with oxygen and fluorine only.
   b) Unlike phosphorous, nitrogen has no tendency for catenation.
7. Complete the following reactions:
   a) $Zn + HNO_3(conc.) \rightarrow$
   b) $Cl_2 + NaOH$ (hot, Con) $\rightarrow$
8. Give equations for the manufacture of
   a) Ammonia from nitrogen b) Nitric acid from ammonia
9. Arrange the following in order of the property mentioned.
   a) HF, HCl, HBr, HI (increasing acid strength)
   b) NH_3, PH_3, AsH_3, SbH_3 (increasing basic strength)
   c) HOCl, HOClO, $HOClO_3$ (increasing oxidizing power) (2010)
10. What are interhalogen compounds? How are they prepared? Why are they more reactive than molecular halogens?
11. Explain why
    a) H_2S is gas while water is liquid at room temperature.
    b) Helium is used in diving apparatus.
    c) Iron dissolves in HCl to form $FeCl_2$ and not $FeCl_3$. (2009)

12. a) Account for the following :

i) Bond angle in NH_4^+ is greater than that in NH_3.

← ii) Reducing character decreases from SO_2 to TeO_2.

← iii) $HClO_4$ is a stronger acid than HClO.

(b) Draw the structures of the following :

i) $H_2S_2O_8$

ii) $XeOF_4$ (2015)

13. a) Complete the following chemical equation:

i) $S_8 + HNO_3(conc.) \rightarrow$

ii) $P_4 + NaOH + H_2O \rightarrow$

b) Explain the following observations:

i) Sulphur in vapour state exhibits paramagnetic behavior.

ii) The stability of +3 state increases down the group in group 15 of the periodic table.

iii) XeF_2 has a linear shape and not a bent structure. (2010)

8 D And F-Block Elements

1. What is Misch metal? Give its use.

2. Why do most of the transition metal ions exhibit characteristic colour in aqueous solution?

3. Why do transition elements show variable oxidation states? How is the variability in oxidation states of d-block different from that of the p-block elements? (2015)

4. What is Lanthanoid contraction? Give its consequences.

5. Explain with equations, how the colour of a solution of $K_2Cr_2O_7$ depends on pH.

6. Complete and balance the following chemical equations:

   $\leftarrow \quad Cr_2O_7^{2-} + I^- + H^+ \rightarrow$
   $\leftarrow \quad MnO_4^- + SO_3^{2-} + H^+ \rightarrow$

7. Answer the following questions:

   a) Why do actonoids in general exhibit a greater range of oxidation states than the Lanthanoids?
   b) Which element in the first series of transition elements does not exhibit variable oxidation states and why? (2007)

8. Describe the preparation of

   a) Potassium dichromate from sodium chromate and
   b) $KMnO_4$ from K_2MnO_4(2016)

9. a) E^0 value for the Mn^{3+}/ Mn^{2+} couple is positive (+ 1.5 V) whereas that of Cr^{3+}/ Cr^{2+} is negative (-0.4 V). Why?

   b) The chemistry of actinoids is not sosmooth as that of lanthanoids. (2011)

   c) Complete the following equation :

   $2MnO_4^- + 16\ H^+ + 5C_2O_4^{2-} \rightarrow$

10. Explain the following observations:

    a) Transition metals generally form coloured compounds.
    b) Zinc is not regarded as a transition metal.
    c) Transition elements and their compounds are generally found to be good catalysts in chemical reactions. (2010)

11. Account for the following:

a) The enthalpy of atomization of the transition metals is high.
b) The lowest oxide of a transition metal is basic; the highest is amphoteric/acidic.
c) Cobalt (II) is stable in aqueous solution but in the presence of complexing agents, it is easily oxidized. (2010)

12. i) Complete and balance the following chemical equations:

a) $Cr_2O_7^{2} + I^{-} + H^{+} \rightarrow$
b) $2MnO_4^{-} + SO_3^{2-} + H^{+} \rightarrow$

ii) How would you account for the following:

a) The oxidizing power of oxoanions are in the order $VO_2^{+} < Cr_2O_7^{2-} < MnO_4^{-}$

b) The third ionization enthalpy of manganese (Z =25) is exceptionally high.

c) Cr^{2+} is a stronger reducing agent than Fe^{2+}. (2011)

9 COORDINATION COMPOUNDS

1. What are ambident ligands? Explain giving example.
2. Write the IUPAC name of the ionization isomer of $[Pt(NH_3)_3Br]Cl$
3. Write the formula of $CrCl_3.5H_2O$ that furnishes 2 moles of Chloride ions per mole of salt.
4. i) Write down the IUPAC name of the following complex :
   $[Pt(NH_3)(H_2O)Cl_2]$

   ii) Write the formula for the following complex :
   tris(ethane-1,2-diamine)chromium(III) chloride
5. Write IUPAC names of the following:
   a) $[Co(NH_3)_5Cl]Cl_2$
   b) $[Cr(NH_3)_6]^{3+}$
6. a) What type of isomerism is shown by $[Co(NH_3)_5ONO]Cl_2$?
   b) On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta o < P$.
   c) Write the hybridization and shape of $[Fe(CN)_6]^{3-}$.
   (Atomic number of Fe = 26) (2015)
7. Give the formula of the compound:
   a) Nitrito – N-pentaamminecobalt(III)nitrate
   b) Potassium hexacyanocobaltate(III)
   c) Hexaammineplatinum(IV)chloride
8. Account for the following
   a) $[Fe(CN)_6]^{3-}$ is weakly paramagnetic while $[Fe(CN)_6]^{4-}$ is diamagnetic.
   b) $[Ni(CO)_4]$ is tetrahedral while $[Ni(CN)_4]^{2-}$ is square planar.
   c) $[Ti(H_2O)_6]^{3+}$ is coloured while $[Sc(H_2O)_6]^{3+}$ is colourless
9. a) For the complex $[Fe(CO)_5]$, write the hybridization, magnetic character and spin of the complex. (At. Number : Fe = 26)
   b) Define crystal field splitting energy. (2016)

10. Describe the state of hybridization, the shape and magnetic behavior of the following complexes:

a) $[Cr(H_2O)_2(C_2O_4)_2]^-$

b) $[Co(NH_3)_2(en)_2]^{3+}$

(At no's: Cr = 24 , Co = 27) (2010)

11. a) What is a ligand? Give an example of a bidentate ligand.

a) Explain as to how the two complexes of nickel, $[Ni(CN)_4]^{2-}$ and $[Ni(CO)_4]$, have different structures but do not differ in their magnetic behavior. (At no: of Ni = 28)

b) Discuss the nature of bonding in metal carbonyls.

10 HALOALKENES AND HALOARENES

1. A solution of KOH hydrolyses $CH_3CHClCH_2CH_3$ and $CH_3CH_2CH_2CH_2Cl$. Which one of these is more easily hydrolyzed? (2010)

2. Draw the structure of the following compound:
   4- Bromo-3-methylpent-2-ene (2010)

3. Write a chemical test to distinguish between:
   a) Chlorobenzene and Benzyl chloride
   b) Chloroform and carbon tetrachloride (2011)

4. An optically active compound having molecular formula $C_7H_{15}Br$ reacts with aq. KOH to give a racemic mixture of products. Write the mechanism involved for the reaction.

5. Arrange in increasing order of property mentioned giving reasons:
   a) Ethanol and ethyl chloride (solubility in water)
   b) 2-Bromo-2-methylbutane, 1-bromopentane, 2-bromopentane (reactivity towards S_N2)

6. Explain why?
   a) Dipole moment of Chlorobenzene is lower than that of Cyclohexylchloride.
   b) Alkyl halides, though polar are immiscible with water.
   c) p-Dichlorobenzene has higher melting point and lower solubility than those of o and m-isomers.

7. How would you differentiate between S_N1 and S_N2 mechanisms of substitution reactions? Give one example of each. (2010)

8. Write short note on the following:
   a) Sandmeyer reaction
   b) Finkelstein reaction
   c) Wurtz reaction.

9. What happens when
   a) Ethyl chloride is treated with NaI in the presence of acetone
   b) Chlorobenzene is treated with Na metal in the presence of dry ether
   c) Methyl chloride is treated with KNO_2 ?
   Write chemical equations in support of your answer. (2015)

10. Give the IUPAC name of the following:

a) a) $(CH_3)_3CCH_2CH(Br)C_6H_5$

b) b) $CH_3C(C_2H_5)_2CH_2Br$

c) c) $CH_3CH=C(Cl)CH_2CH(CH_3)_2$

d) $CHF_2CBrClF$

e) $(CH_3)_3CCH=CClC_6H_5$

11. Give reasons:

a) Alkyl halides have higher boiling points than corresponding hydrocarbons.

b) Benzylic and allylic halides follow S_N1 mechanism.

c) Halogens are deactivating but 'o, p' directive.

d) Presence of electron withdrawing groups on benzene ring increases tendency of S_N reaction.

e) Haloalkanes are more reactive than haloarenes towards nucleophilic substitution reactions.

12. Bring about the following conversions:

a) Benzene to 4-bromonitrobenzene

b) Benzyl alcohol to 2-phenylethanoic acid

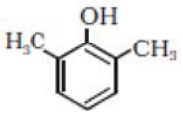
c) Toluene to benzylalcohol

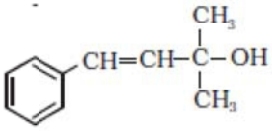
d) Propene to 1-propanol

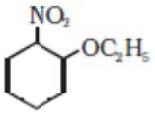
e) Chlorobenzene to toluene

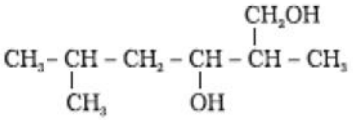
11 Alcohols, Phenols And Ethers

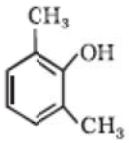
1. Name the following compounds according to the IUPAC system:

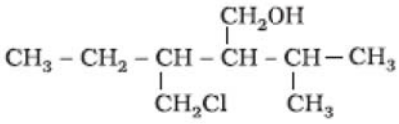
i) 

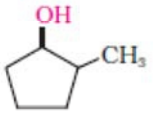
ii) 

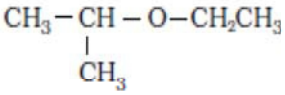
iii) 

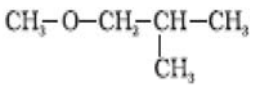
iv) 

v) 

vi) 

vii) 

viii) 

ix) 

x) $C_2H_5OCH_2CH_2CH_2OH$

2 Account for the following:

i) C – O – H bond angle in alcohol is less than tetrahedral angle.

ii) C – O bond length in phenol is shorter than that in methanol.

iii) C – O – C bond angle in ether is greater than the tetrahedral angle.

iv) The boiling points of alcohols and phenols are higher than corresponding alkanes of same molecular mass.

v) Among the isomeric alcohols the boiling point follows the order $3^0 < 2^0 < 1^0$.

vi) Lower alcohols are soluble in water

vii) Ethanol is less acidic than methanol.

viii) The acidic character of the alcohols follows the order $1^0 > 2^0 > 3^0$

ix) The reaction of alcohol with acid is carried out in presence of small amount of concentrated H_2SO_4.

x) Reaction of alcohol with acid chloride is carried out in presence of a base pyridine.

3. Effect the following conversions:

i)	Chloro benzene to phenol	vi)	Propene to 1-Propanol
ii)	Benzene sulphonic acid to phenol	vii)	Propene to 2-propanol
iii)	Ethanol to isopropyl alcohol	viii)	Phenol to anisole
iv)	Phenol to picric acid	ix)	Phenol to aspirin
v)	Phenol to p-hydroxy acetophenone	x)	Aniline to phenol

4. Arrange the following on the increasing property given in bracket:

a) Pentan-1-ol, butan-1-ol, butan-2-ol, ethanol, propan-1-ol, methanol (Boiling Point)
b) Pentan-1-ol, n-butane, pentanal, Ethoxyethane (Boiling point)
c) Propan-1-ol, 2, 4, 6 – trinitro phenol, 3,5 – dinitro phenol, 4-methylphenol (Acidity)
d) Ter. Butyl alcohol, isobutyl alcohol, n-butyl alcohol (Acidity)
e) 4-nitro phenol, phenol, 2,4,6-trinitro phenol (Acid strength)

5. Write short note on the following:

i) Hydroboration
ii) Reimer – Tiemann Reaction.
iii) Friedel-Craft's reaction
iv) Kolbe's reaction
v) Williamson's synthesis

6. Write the mechanism of the following:
Acid catalyzed dehydration of ethanol to diethyl ether.

12 Aldehydes, Ketones And Carboxylic Acids

1. Write short notes on the following: (1 x 6 = 6)

   a. Clemmensen reduction
   b. Aldol Condensation(2008)
   c. Rosenmund reduction (2011)
   d. Hell-Volhard-Zelinsky
   e. Cannizzaro reaction
   f. Cross Aldol Condensation reaction (2014)

2. Give the structure of the following: (1 x 5 = 5)

   a. Hex-2-en-4-ynoic acid
   b. 3-hydroxy butanal
   c. *p*-Nitropropiophenone
   d. 3-Bromo-4-phenylpentanoic acid
   e. 3-Methylcyclohexane carbaldehyde

3. Explain the following mechanisms:

   a) Nucleophilic attack on a carbonyl group of an aldehyde or a ketone.
   b) Nucleophilic addition of Grignard reagent on a carbonyl group of an aldehyde or a ketone.

4. Distinguish the following:

   a) Formic acid and Acetic acid
   b) Phenol and benzoic acid (2014)
   c) Benzaldehyde and ethanal
   d) Benzaldehyde and acetophenone (2010)

5. Give the structure of the following:

   a) Hex-2-en-4-ynoic acid
   b) 2,3- dimethylcyclopentane carbaldehyde
   c) *p*-Nitropropiophenone

6. Arrange the following in the increasing order of the property given as indicated:

   a) Acetaldehyde, acetone, Di-ter-butylketone, methyl-ter-butylketone (Reactivity towards HCl)
   b) 2-Bromobutanoic acid, 3-bromobutanoic acid, 2-methypropanoic acid, butanoic acid (Acid strength)
   c) CH_3CHO, CH_3CH_2OH, CH_3OCH_3, $CH_3CH_2CH_3$ (Boiling point)
   d) Ethanal, Propanal, Propanone, Butanone (Nucleophilic addition)
   e) Benzoic acid , 4- nitrobenzoic acid , 3,4- dinitrobenzoic acid , 4- methoxybenzoic acid (acid strength)

7. Effect the following conversions:

   a. Propanone to propene
   b. Propanal to 2-butanone
   c. Ethanol to 3-hydroxy butanal
   d. Benzaldehyde to 2-hydroxyphenyl acetic acid.

8. Account for the following:

   a) Carboxylic acids do not give reactions of carbonyl group . (2014)
   b) Aldehydes are more reactive to nucleophilic addition than ketones. (2008)

c) Carboxylic acids have higher boiling points than aldehyde, ketones and even alcohols of comparable molecular mass. (2008)

d) Chloroacetic acid is stronger than acetic acid. (2014)

e) There is two $-NH_2$ groups in semicarbazide , however only one is involved in the formation of semicarbazone.

9. a) An organic compound A contains 69.77% carbon, 11.63% hydrogen and rest oxygen. The molecular mass of the compound is 86. It does not reduce Tollens' reagent but forms an addition compound with sodium hydrogen sulphite and give positive iodoform test. On vigorous oxidation it gives ethanoic and propanoic acid. Write the possible structure of the compound A.

b) Write the chemical tests to distinguish between the following pairs of compounds:

i. Acetophenone and Benzophenone

ii. Ethanol and Propanal (2008)

13 AMINES

1. Why do amines react as nucleophiles? (2007)
2. Write a chemical reaction in which the iodide ion replaces the diazonium group in a diazonium salt. (2008)
3. Give the IUPAC name of $H_2N\text{-}CH_2\text{-}CH_2CH{=}CH_2$ (2010)
4. Why is an alkylamine more basic than ammonia? (2011)
5. Effect the following conversions:
   a) Aniline to p-nitro aniline
   b) Benzyl bromide to 2-Phenyl ethanamine
   c) Acetaldehyde to ethyl amine
   d) Nitro Benzene to Benzene
   e) Methyl cyanide to acetone
6. Account for the following:
   a) Diazonium salts of aromatic amines are more stable than those of aliphatic amines.
   b) Amines are more basic than alcohols of comparable molecular masses. (2011)
7. Illustrate the following reactions giving a chemical equation in each case:
   a) Carbylamine reaction
   b) Coupling reaction
   c) Gabriel-Phthalimide synthesis
8. Give the structures of A , B and C in the following reactions:
   a) $CH_3CH_2I \xrightarrow{NaCN} A \xrightarrow[\text{Partial hydrolysis}]{OH^-} B \xrightarrow{Br_2} C$
   b) $C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow[273\ K]{} B \longrightarrow C$
9. Effect the following conversions:
   a) Aniline to p-nitro aniline
   b) Benzyl bromide to 2-Phenyl ethanamine
   c) Acetaldehyde to ethyl amine
   d) Nitro Benzene to Benzene
   e) Methyl cyanide to acetone

14 BIOMOLECULES

1. What are the three types of RNA molecules which perform different functions? (2013)

2. What type of bonding helps in stabilizing the (2013)

3. Name the products of hydrolysis of lactose.

4. What is denaturation of protein?

5. Write the important structural difference between DNA and RNA. Of the two bases, thymine and uracil, which one is present in DNA? (2012)

6. Name the products obtained on reaction of glucose with
   a) HI b) HNO_3

7. State what you understand by primary structure and secondary structure of proteins. (2011)

8. What are essential and non-essential amino acids? Give one example of each type. (2010)

9. Differentiate between
   a) Amylose and amylopectin
   b) Fibrous and globular proteins
   c) Nucleoside and nucleotide

10. Name a disease that is caused due to the deficiency of the following vitamins:
    a) Thiamine (b) Riboflavin (c) D

11. The two strands in DNA are not identical but are complementary. Explain. (2011)

12. a) What is glycogen? How is it different from starch?
    b) How is starch structurally different from cellulose?
    c) Explain what is meant by the following:
    Peptide linkage and Pyranose structure of glucose (2012)

15 POLYMERS

1. How does vulcanization change the property of rubber?
2. Explain the term 'homopolymerisation' giving an example. (2012)
3. What is PHBV? Give its importance
4. Explain the term copolymerization and give two examples.
5. Give chemical equations for the preparation of
   (a) PHBV (b) Melamine
6. Differentiate between molecular structure and behaviours of thermoplastic and thermosetting polymers. Give one example of each type. (2012)
7. Arrange the following polymers in the increasing order of their intermolecular forces. Also classify them as addition and condensation polymers.
   a) Nylon 6, 6 ; Buna –S , rubber , Polystyrene.
   b) Nylon – 6, neoprene and PVC
   c) Polystyrene, terylene, natural rubber (2013)
8. Explain the classification of polymers on the basis of structure?
9. Write the free radical mechanism for the polymerisation of ethene.
10. Give equations for the synthesis of
    a) Terylene
    b) Neoprene
    c) Teflon
11. Write the monomer and use of the following polymer
    a) PVC
    b) Urea – formaldehyde resin
    c) Bakelite
12. Differentiate between:
    a) Thermosetting and thermoplastics.
    b) Addition and condensation polymers
    c) LDP and HDP
    d) Nylon-6 and Nylon-6,6
    e) Homo-polymer and co-polymer

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