

**BUDHA DAL PUBLIC SCHOOL, PATIALA**  
**First Term Examination (6 September 2023)**

Class XII (Science)  
Subject - Chemistry  
(Set - A)

Time: 3hrs.

M.M. 70

General Instructions:

1. There are 33 questions in this question paper with internal choice.
2. Section A consists of 16 multiple-choice questions carrying 1 mark each.
3. Section B consists of 5 short answer questions carrying 2 marks each.
4. Section C consists of 7 short answer questions carrying 3 marks each.
5. Section D consists of 2 case-based questions carrying 4 marks each.
6. Section E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

Section - A

Q1. Solubility of gases in liquids decreases with rise in temperature because dissolution is an

- a) endothermic and reversible process    b) exothermic and reversible process  
c) endothermic and irreversible process    d) exothermic and irreversible process

Q2. Intermolecular forces between two benzene molecules are nearly of same strength as those between two toluene molecules. For a mixture of benzene and toluene, which of the following is not true?

- a)  $\Delta_{mix}H = zero$     b)  $\Delta_{mix}V = zero$   
c) these will form minimum boiling azeotrope    d) these will form an ideal solution

Q3. The correct cell to represent the following reaction



- a)  $2Ag|Ag^+||Zn|Zn^{2+}$     b)  $Ag^+|Ag||Zn^{2+}|Zn$     c)  $Ag|Ag^+||Zn|Zn^{2+}$     d)  $Zn|Zn^{2+}||Ag^+|Ag$

Q4.  $\Delta_m^0(NH_4OH)$  is equal to \_\_\_\_\_

- (a)  $\Delta_m^0(NH_4OH) + \Delta_m^0(NH_4Cl) - \Delta_m^0(HCl)$     (b)  $\Delta_m^0(NH_4Cl) + \Delta_m^0(NaOH) - \Delta_m^0(NaCl)$   
(c)  $\Delta_m^0(NH_4Cl) + \Delta_m^0(NaCl) - \Delta_m^0(NaOH)$     (d)  $\Delta_m^0(NaOH) + \Delta_m^0(NaCl) - \Delta_m^0(NH_4Cl)$

Q5. The unit of the rate of reaction is the same as that of the rate constant for a

- a) first order reaction    b) zero order reaction  
c) second order reaction    d) any of the reactants is in excess

Q6. In the presence of a catalyst, the heat evolved or absorbed during the reaction \_\_\_\_\_.

- a) increases    b) decreases    c) remains unchanged    d) may increase or decrease

Q7. Which of the following is the reason for Zinc not exhibiting variable oxidation state?

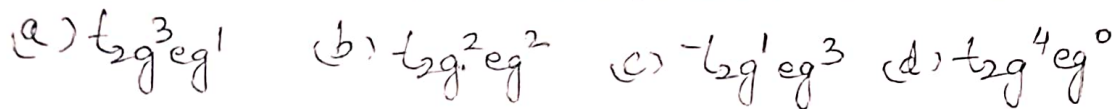
- a) Inert pair effect    b) completely filled 3d subshell  
c) completely filled 4s subshell    d) common ion effect

Q8. Gadolinium belongs to 4f series. It's atomic number is 64. Which of the following is the correct electronic configuration of gadolinium?

- a)  $[Xe]4f^7 5d^1 6s^2$     b)  $[Xe]4f^6 5d^2 6s^2$     c)  $[Xe]4f^8 6d^2$     d)  $[Xe]4f^9 5s^1$

A-1

- Q9. Which property of transition metals enables them to behave as catalysts?  
 a) High melting point b) High ionization enthalpy c) Alloy formation d) Variable oxidation states
- Q10. Ambidentate ligands like  $NO_2^-$  and  $SCN^-$  are  
 a) Unidentate b) didentate c) polydentate d) has variable denticity
- Q11. The compounds  $[Co(SO_4)(NH_3)_5]Br$  and  $[Co(Br)(NH_3)_5]SO_4$  represent :  
 a) Optical isomerism b) linkage isomerism c) ionization isomerism d) coordination isomerism
- Q12. On the basis of crystal field theory, electronic configuration of  $d^4$  complex when  $\Delta_0 > P$  is



In the following questions, two statements are given - one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to the questions from the codes (a), (b), (c) and (d) as given below:

- a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).  
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 d) Assertion (A) is incorrect, but Reason (R) is correct statement.
- Q13. Assertion (A) : Non-ideal solution for azeotropic mixture.  
 Reason (R) : Maximum boiling azeotropes are formed by a solution showing negative deviation.
- Q14. Assertion (A) : A raw mango placed in a saline solution loses water and shrivel into pickle.  
 Reason (R) : Through the process of reverse osmosis, raw mango shrivel into pickle.
- Q15. Assertion (A) :  $\Lambda_m$  for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.  
 Reason (R) : For weak electrolytes, degree of dissociation decreases with dilution of solution.
- Q16. Assertion (A) : Hydrolysis of an ester follows first order kinetics.  
 Reason (R) : Concentration of water remains nearly constant during the course of the reaction.

Section - B

- Q17. State Henry's law and mention some important applications.
- Q18. What is lanthanoid contraction? What are the consequences of lanthanoid contraction?
- Q19. Explain why  $Cu^+$  ion is not stable in aqueous solutions?
- Q20. Using IUPAC norms, write the formulae of the following:  
 a) Tetrahydrozincate (II) b) Potassium tri(oxalato) chromate (III)
- Q21. Explain on the basis of valence bond theory that  $[Ni(CN)_4]^{2-}$  ion with square planar structure is diamagnetic and the  $[NiCl_4]^{2-}$  ion with tetrahedral geometry is paramagnetic.

OR

Draw the structure of optical isomers of

- a)  $[Cr(C_2O_4)_3]^{3-}$  b)  $[Cr(NH_3)_2Cl_2(en)]^+$



Section - C

Q22. Calculate the osmotic pressure in pascals exerted by a solution prepared by dissolving 1.0 g of polymer of molar mass 185,000 in 450 mL of water at 37°C.

Q23. Depict the galvanic cell in which the reaction  $Zn(s) + 2Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$  takes place. Further show :

a) Which of the electrode is negatively charged?

b) The carriers of the current in the cell.

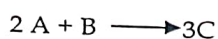
Q24. How much electricity in terms of Faraday is required to produce

a) 20.0 g of Ca from molten  $CaCl_2$ ?

b) 40.0 g of Ca from molten  $Al_2O_3$ ?

Q25. The rate of the chemical reaction doubles for an increase of 10 K in absolute temperature from 298 K. Calculate  $E_a$ .

Q26. For an elementary reaction



The rate of appearance of C at time 't' is  $1.3 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$ .

Calculate at this time

a) Rate of the reaction

b) Rate of disappearance of A.

Q27. Explain giving reasons :

a) Transition metals and many of their compounds show paramagnetic behaviour.

b) The transition metals generally form coloured compounds.

c) Transition metals and their many compounds act as good catalyst.

OR

Compare the chemistry of the actinoids with that of lanthanoids with reference to :

a) Electronic configuration b) oxidation states and c) chemical reactivity

Q28. What is crystal field splitting energy? How does the magnitude of  $\Delta_0$  decide the actual configuration of d-orbitals in a coordination entity?

Section - D

Q29. Read the passage given below and answer the following questions:

Potassium permanganate, ( $KMnO_4$ ) is prepared by fusion of pyrolusite,  $MnO_2$ , with  $KOH$  in the presence of an oxidizing agent like  $KNO_3$ . This produces the dark green potassium manganate,  $K_2MnO_4$  which disproportionates in a neutral or acidic solution to give purple permanganate ion. Potassium permanganate is an important oxidizing agent in acidic, alkaline as well as neutral medium.

a) What is the state of hybridisation of Mn in  $MnO_4^-$ ?

b) Write an application of potassium permanganate.

c) What are the products formed after heating potassium permanganate?

OR

Draw the structure of permanganate ion. Is it paramagnetic or diamagnetic?

Q30. Read the following passage and answer the questions that follow:

In coordination compounds, metals show two types of linkages, primary and secondary. Primary valencies are ionisable and are satisfied by negatively charged ions. Secondary valencies are non-ionisable and are satisfied by neutral or negative ions having lone pair of electrons. Primary valencies are non-directional while secondary valencies decide the shape, of the complexes.

1. If  $\text{PtCl}_2 \cdot 2\text{NH}_3$  does not react with  $\text{AgNO}_3$ , what will be its formula?
2. What is the secondary valency of  $[\text{Co}(\text{en})_3]^{3+}$ ?
3. a) Write the formula of Iron (III) hexacyanidoferrate (II).  
b) Write the IUPAC name of  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ .

OR

Write the hybridization and magnetic behaviour of  $[\text{Ni}(\text{CN})_4]^{2-}$   
(Atomic Number : Ni = 28)

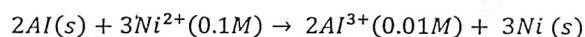
- Q31. a) Write two differences between 'order of reaction' and 'molecularity of reaction'  
b) A first order reaction takes 40 min for 30% decomposition. Calculate  $t_{1/2}$ .
- Q32. a) What is meant by positive and negative deviations from Raoult's law?  
b) A 5% solution (by mass) of cane sugar in water has a freezing point of 271 K. Calculate the freezing point of a 5% glucose in water if the freezing point of pure water is 273.15 K.

OR

- a) Give reasons :
- i) Cooking is faster in pressure cooker than in cooking pan.
  - ii) Red Blood Cells (RBC) shrink when placed in saline water but swell in distilled water.
- b) Vapour pressure of pure water at 298 K is 23.8 mm Hg. 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.
- Q33. a) What type of battery is lead storage battery? Write the anode and cathode reactions and the overall cell reaction occurring in the operation of a lead storage battery.  
b) Resistance of a conductivity cell filled with  $0.1 \text{ mol L}^{-1}$  KCl solution is  $100 \Omega$ . If the resistance of the same cell when filled with  $0.02 \text{ mol L}^{-1}$  KCl solution is  $520 \Omega$ , calculate the conductivity and molar conductivity of  $0.02 \text{ mol L}^{-1}$  KCl solution. The conductivity of  $0.1 \text{ mol L}^{-1}$  KCl solution is  $1.29 \times 10^{-2} \Omega^{-1} \text{ cm}^{-1}$ .

OR

- a) Represent the cell in which the following reaction takes place :



Calculate the emf if  $E_{\text{cell}}^{\circ} = 1.41 \text{ V}$ .

- b) How does molar conductivity vary with increase in concentration for strong electrolyte and weak electrolyte? How can you obtain limiting molar conductivity  $\Lambda_m^{\circ}$  for weak electrolyte?

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Section - A

- Q1. Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law?
- a) Methanol and acetone      b) Chloroform and acetone  
c) Nitric acid and water      d) Phenol and aniline
- Q2. The colligative property used for the determination of molar mass of polymers and proteins is
- a) Osmotic pressure      b) depression in freezing point  
c) relative lowering in vapour pressure      d) elevation in boiling point
- Q3. An electrochemical cell can behave like an electrolytic cell when
- a)  $E_{cell} = 0$       b)  $E_{cell} > E_{ext}$       c)  $E_{ext} > E_{cell}$       d)  $E_{cell} = E_{ext}$
- Q4. Using the data given below find out the strongest reducing agent
- $E_{Cr_2O_7^{2-}/Cr^{3+}}^0 = 1.33 V$ ,       $E_{Cl_2/Cl^-}^0 = 1.36 V$ ,       $E_{MnO_4^-/Mn^{2+}}^0 = 1.51 V$ ,       $E_{Cr^{3+}/Cr}^0 = -0.74 V$
- a)  $Cl^-$       b) Cr      c)  $Cr^{3+}$       d)  $Mn^{2+}$
- Q5. If 75% of the first-order reaction was completed in 32 minutes, 50% of the same reaction would be completed in
- a) 8 min      b) 4 min      c) 16 min      d) 24 min
- Q6. Which of the following is affected by catalyst?
- a)  $\Delta H$       b)  $\Delta G$       c)  $E_a$       d)  $\Delta S$
- Q7. Which of the following is the reason for Zinc not exhibiting variable oxidation state?
- a) Inert pair effect      b) completely filled 3d subshell  
c) completely filled 4s subshell      d) common ion effect
- Q8. Out of the following transition elements, the maximum number of oxidation states are shown by
- a) Sc (Z = 21)      b) Cr (Z = 24)      c) Mn (Z = 25)      d) Fe (Z = 26)
- Q9. On addition of small amount of  $KMnO_4$  to concentrated  $H_2SO_4$ , a green oily compound is obtained which is highly explosive in nature. Identify the compound from the following
- a)  $Mn_2O_7$       b)  $MnO_2$       c)  $MnSO_4$       d)  $Mn_2O_3$

B-1



Q10. When 1 mol  $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$  is treated with excess of  $\text{AgNO}_3$ , 3 mol of  $\text{AgCl}$  are obtained. The formula of the complex is :

- a)  $[\text{CrCl}_3(\text{H}_2\text{O})_3] \cdot 3\text{H}_2\text{O}$       b)  $[\text{CrCl}_2(\text{H}_2\text{O})_4]\text{Cl} \cdot 2\text{H}_2\text{O}$   
c)  $[\text{CrCl}(\text{H}_2\text{O})_5]\text{Cl}_2 \cdot \text{H}_2\text{O}$       d)  $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$

Q11. EDTA is a

- a) monodentate ligand    b) bidentate ligand    c) ambidentate ligand    d) hexadentate ligand

Q12. Atomic number of Mn, Fe and Co are 25, 26 and 27 respectively. Which of the following inner orbital octahedral complexes ions are diamagnetic?

- a)  $[\text{Co}(\text{NH}_3)_6]^{3+}$     b)  $[\text{Mn}(\text{CN})_6]^{3-}$     c)  $[\text{Fe}(\text{CN})_6]^{4-}$     d)  $[\text{Fe}(\text{CN})_6]^{2-}$

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Q13. Assertion (A) : Aquatic species are more comfortable in cold water rather than in warm water.

Reason (R) : Different gases have different  $K_H$  values at the same temperature.

Q14. Assertion (A) : An ideal solution obeys Henry's law.

Reason (R) : In an ideal solution, solute-solute as well as solvent-solvent interactions are similar to solute-solvent interaction.

Q15. Assertion (A) : Electrolysis of  $\text{NaCl}$  solution gives chlorine at anode instead of  $\text{O}_2$ .

Reason (R) : Formation of oxygen at anode requires overvoltage.

Q16. Assertion (A) : The molecularity of the reaction  $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$  appears to be 2.

Reason (R) : Two molecules of the reactants are involved in the given elementary reaction.

#### Section - B

Q17. Define the following terms : (a) mole fraction    (b) molality

Q18. How would you account for the irregular variation of ionization enthalpies (first and second) in first series of the transition elements?

Q19. What are interstitial compounds? Why are such compounds well known for transition metals?

Q20. Using IUPAC norms, write the formulae of the following:

- a) diamminedichloridoplatinum (II)    b) Potassium tetracyanonickelate (II)

Q21.  $[\text{Ni}(\text{CN})_4]^{2-}$  is paramagnetic while  $[\text{Ni}(\text{CO})_4]$  is diamagnetic though both are tetrahedral. Why?

OR

Explain  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is an inner orbital complex whereas  $[\text{Ni}(\text{NH}_3)_6]^{2+}$  is an outer orbital complex.

#### Section - C

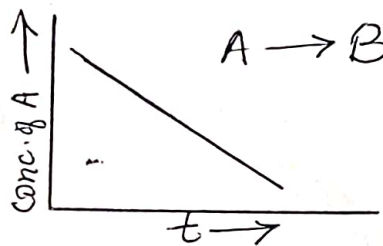
Q22. Concentrated nitric acid used in the laboratory is 68% nitric acid by mass in aqueous solution. What should be the molarity of such a sample of the acid if the density of the solution is  $1.504 \text{ g mol}^{-1}$ ?

Q23. State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decrease with dilution?

B-2

- Q24. Give three points of differences between electrochemical cell and electrolytic cell.
- Q25. The rate of a reaction quadruples when the temperature changes from 293 K to 313 K. Calculate the energy of activation of the reaction assuming that it does not change with temperature.

- Q26. For an general reaction  $A \rightarrow B$ , plot of concentration of A vs time is given in figure. Answer the following questions on the basis of this graph.



- What is the order of the reaction?
- What is the slope of the curve?
- What are the units of rate constant?

- Q27. Give example and suggest reasons for the following features of the transition metal chemistry :
- The lowest oxide of transition metal is basic, the highest is amphoteric/acidic.
  - A transition metal exhibits higher oxidation states in oxides and fluorides.
  - The highest oxidation state is exhibited in oxo-anions of a metal.

OR

Indicate the steps in the preparation of

- $K_2Cr_2O_7$  from chromite ore
- $KMnO_4$  from pyrolusite ore

- Q28. In a coordination entity, the electronic configuration of the central metal ion is  $t_{2g}^3 e_g^1$ .

- Is the coordination compound a high spin or low spin complex?
- Draw the crystal field splitting diagram for the above complex?

Section - D

- Q29. Read the passage given below and answer the following questions:

Within the 3d-series, manganese exhibits oxidation states in aqueous solution from +2 to +7, ranging from  $Mn^{2+}$  (aq) to  $MnO_4^-$  (aq). Likewise, iron forms both  $Fe^{2+}$ (aq) and  $Fe^{3+}$ (aq) as well as the  $FeO_4^{2-}$  ion. Cr and Mn form oxyions  $CrO_4^{2-}$ ,  $MnO_4^-$ , owing to their willingness to form multiple bonds. The pattern with the early transition metals in the 3d series up to Mn, and for the 4d, 5d metals up to Ru and Os-is that the maximum oxidation state corresponds to the number of "outer shell" electrons. The highest oxidation states of the 3d-metals may depend upon complex formation (e.g., the stabilization of  $Co^{3+}$  by ammonia) or upon the pH (thus  $MnO_4^{2-}$  (aq) is prone to disproportionation in acidic solution). Within the 3d-series, there is considerable variation in relative stability of oxidation states, sometimes on moving from one metal to a neighbour; thus, for iron,  $Fe^{3+}$  is more stable than  $Fe^{2+}$ , especially in alkaline conditions, while the reverse is true for cobalt. The ability of transition metals to exhibit a wide range of oxidation states is marked with metals such as vanadium, where the standard potentials can be rather small, making a switch between states relatively easy.

- What is the oxidation state of iron in ferric?
- Which is more stable  $Fe^{2+}$  or  $Fe^{3+}$  ?
- Why is the maximum oxidation state of chromium in its compounds +6?

OR

Vanadium had the ability to exhibit a wide range of oxidation states. Explain why?

- Q30. Read the following passage and answer the questions that follow:

The coordination compounds are of great importance. These compounds are widely present in the mineral, plant and animal worlds and are known to play many important functions in the area of analytical chemistry, metallurgy, biological systems, industry and medicine. Formation of coordination compounds is largely used in analytical chemistry for the qualitative detection and quantitative estimation of metal ions. Coordination compounds also find several important applications in the field of medicine. Several coordination compounds are also used as antidote to poisoning caused by the ingestion of poisonous metals by human beings.



1. Which complexing material is added to vegetable oils to remove the ill effects of undesired metal ions?
2. Which complex is used in the treatment of cancer?
3. How would you detect the presence of nickel in a food sample?

OR

What is chelate therapy?

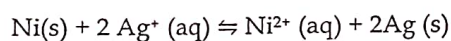
(Atomic Number : Ni = 28)

- Q31. a) State Henry's law and mention two important applications.  
 b) Determine the osmotic pressure of a solution prepared by dissolving 25mg of  $K_2SO_4$  in 2 litre of water of  $25^\circ C$ , assuming that it is completely dissociated.

- Q32. a) Predict the products of electrolysis in each of the following:  
 i) An aqueous solution of  $AgNO_3$  with silver electrodes.  
 ii) An aqueous solution of  $AgNO_3$  with platinum electrodes.  
 iii) A dilute solution of  $H_2SO_4$  with platinum electrodes.  
 b) Write the name of the cell which is generally used in hearing aids. Write the reactions taking place at the anode and the cathode of this cell.

OR

- a) Conductivity of  $2 \times 10^{-3} M$  methanoic acid is  $8 \times 10^{-5} S cm^{-1}$ . Calculate its molar conductivity and degree of dissociation of  $\Lambda_m^0$  for methanoic acid is  $404 S cm^2 mol^{-1}$ .  
 b) Calculate the  $\Delta_r G^0$  and  $\log K_c$  for the given reaction at 298 K.



[Given :  $E_{Ni^{2+}/Ni}^0 = 0.25V$ ,  $E_{Ag^+/Ag}^0 = +0.80V$   $1F = 96500 C mol^{-1}$ ]

- Q33. For the hydrolysis of methylacetate in aqueous solution, the following results were obtained :

t/s	0	30	60
$[CH_3COOCH_3]/mol L^{-1}$	0.60	0.30	0.15

- a) Show that it follows pseudo first order reaction, as the concentration of water remains constant.  
 b) Calculate the average rate of reaction between the time interval 30 to 60 seconds.  
 [Given  $\log 2 = 0.3010$ ,  $\log 4 = 0.6021$ ]

OR

- a) For a reaction :  $2NH_3(g) \xrightarrow{Pt} N_2(g) + 3H_2(g)$

Rate = k

- i) Write the order and molecularity of this reaction .  
 ii) Write the unit of k.  
 b) For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction.