# BUDHA DAL PUBLIC SCHOOL, PATIALA
## First Term Examination (9 September 2024)
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. Low concentration of oxygen in the blood and tissues of people living at high altitude is due to

a) high atmospheric pressure b) low temperature

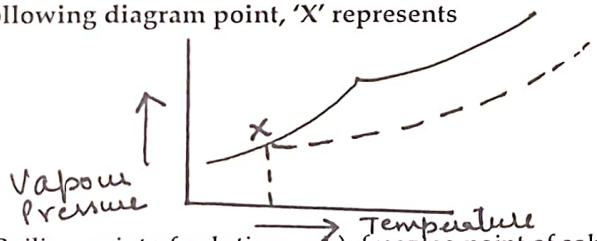
c) low atmospheric pressure d) both low temperature and high atmospheric pressure

Q2. Which one of the following pairs will not form an ideal solution?

a) Benzene and Toluene b) Nitric acid and Water

c) Hexane and Heptane d) Phenol and aniline

Q3. In the following diagram point, 'X' represents




a) Boiling point of solution b) freezing point of solvent

c) boiling point of solvent d) freezing point of solution

Q4. $\Delta G$ *and* $E^0_{cell}$ for a spontaneous reaction will be

a) Positive, negative b) negative, negative c) negative, positive d) positive, positive

Q5. The half-life of a first order reaction is 69.3 sec. The value of rate constant of the reaction is

a) 1.0 $s^{-1}$ b) 0.1 $s^{-1}$ c) 0.01 $s^{-1}$ d) 0.001 $s^{-1}$

Q6. The slope in the plot of In[R] vs. time for a first order reaction is

a) $\frac{+k}{2.303}$ b) $-k$ c) $\frac{-k}{2.303}$ d) $+k$

Q7. 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)

Q8. Which of the following characteristics of transition metals is associated with their catalytic activity?

a) Paramagnetic nature b) colour of hydrated ions

c) High enthalpy of atomization d) variable oxidation states

Q9. The formula of the complex dichloridobis (ethane -1, -2 – diamine) platinum (IV) nitrate is

a) $[Pt\,Cl_2\,(en)_2\,(NO_3)_2]$ b) $[PtCl_2\,(en)_2\,(NO_3)_2]$ c) $[Pt\,Cl_2\,(en)_2\,(NO_3)]NO_3$ d) $[Pt\,(en)_2\,(NO_3)_2]Cl_2$

A-1

Q10. EDTA is

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

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

a) $t_{2g}^3 e_g^1$ (b) $t_{2g}^2 e_g^2$ (c) $t_{2g}^1 e_g^3$ d) $t_{2g}^4 e_g^0$

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).

b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).

c) Assertion (A) is correct, but Reason (R) is incorrect statement.

d) Assertion (A) is incorrect, but Reason (R) is correct statement.

Q13. 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.

Q14. Assertion (A) : Hydrolysis of an ester follows first order kinetics.

Reason (R) : Concentration of water remains nearly constant during the course of the reaction.

Q15. Assertion (A) : Transition metals have low melting points.

Reason (R) : The involvement of greater number of (n-1)d and ns electrons in the interatomic metallic bonding.

Q16. Assertion (A) : The complex $[Cr(H_2O)_3Cl_3]$ does not give precipitate with $AgNO_3$ solution.

Reason (R) : The complex $[Cr(H_2O)_3Cl_3]$ is non-ionizable.

**Section - B**

Q17. If a current of 0.5 amphere flows through a metallic wire for 2 hours, then how many electrons would flow through the wire?

OR

The conductivity of 0.20 M solution of KCl at 298K is 0.0248 $Scm^{-1}$. Calculate its molar conductivity.

Q18. Explain why $Cu^+$ ion is not stable in aqueous solution.

Q19. Why are $Mn^{2+}$ compounds more stable than $Fe^{2+}$ compound towards oxidation to their +3 state?

Q20. $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral. Why? [atomic no. of Ni = 28]

Q21. Write all the geometrical isomers of $[Pt(NH_3)\,(Br)(Cl)(py)]$ and how many of these will exhibit optical isomerism?

**Section – C**

Q22. a) Give reasons :

Red blood cells shrink when placed in saline water but swell in distilled water.

b) Determine the osmotic pressure of a solution prepared by dissolving 25mg of $K_2SO_4$ in 2 litre of water at 25°C, assuming that it is completely dissociated. (Atomic mass of K=39, S=32, O=16)

Q23. a) Out of two 0.1 molal aqueous solutions of glucose and of potassium chloride, which one will have a higher boiling point and why?

b) 19.5g of $CH_2F$ COOH (molar mass = 78g/mol) is dissolved in 500g of water. The depression in the freezing point observed to be $1^0$C. Calculate the Van't Hoff factor? (kf for water = 1.86K kg/mol)

Q24. a) Write the Nernst equation and emf of the following cells at 298k

$Fe(s)\left|Fe^{2+}(0.001M)\right|\left|H^+(1M)\right|H_2(g)(1\ bar)\left|\ Pt(s)\right.$ $(E^0Fe^{2+}\left|\ Fe = -0.44V\right.)$

b) How much charge is required for the following reduction :

1 mol of $Al^{3+}$ to Al

Q25. The rate of a reaction quadruples where the temperature changes from 293K to 313K. Calculate the energy of activation of the reaction assuming that it does not change with temperature. (log 2 = 0.3010)

Q26. Explain the giving reasons

a) The transition metals generally form coloured compounds.

b) Out of $d^4$ species $Cr^{2+}$ is strong by reducing while manganese (III) is strongly oxidizing.

c) The enthalpies of atomisation of the transition metals are high.

Q27. Describe the preparation of potassium dichromate from iron chromite ore. What is the effect of increasing pH on a solution of potassium dichromate.

Q28. Write the hybridization, shape and magnetic behaviour of the following complex on the basis of valence bond theory

a) $[CO\ (C_2O_4)_3]^{3-}$ b) $[Cr\ (NH_3)_6]^{3+}$ (Atomic no. of Co = 27 and Cr = 24)

OR

a) On the basis of crystal field theory, write the electronic configuration for $d^5$ ion with a weak ligand for which $\Delta_0 < P$

b) Explain $[Fe(CN)_6]^{3-}$ is an inner orbital complex whereas $[FeF_6]^{3-}$ is an outer orbital complex. (atomic no. Fe = 26)

Section - D

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

A lead storage battery is the most important type of secondary cell having a lead anode and a grid of lead packed with $PbO_2$ as cathode. A 38% solution of sulphuric acid issued as electroyle.

(Density=1.294g $mL^{-1}$). The batter holds 3.5 L of the acid. During the discharge of the battery, the density of $H_2SO_4$ falls to 1.139 g $mL^{-1}$. (20% $H_2SO_4$ by mass) (Molar mass $H_2SO_4$ = 98 g/mol)

a) Write the reaction taking place at the cathode when the battery is in use.

b) How much electricity in terms of Faraday is required to carry out the reduction of one mole of $PbO_2$?

c) What is molarity of sulphuric acid before discharge?

OR

a) Lead storage battery is considered a secondary cell. Why?

b) Write the products of electrolysis when dilute sulphuric acid is electrolysed using Platinum electrodes.

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

The rate of reaction is concerned with decrease in concentration of reactants or increase in the concentration of products per unit time. It can be expressed as instantaneous rate at a particular instant of time and average rate over a large interval of time. A number of factors such as temperature, concentration or reactants, catalyst affect the rate of reaction. Mathematical representation of rate of a reaction is given by rate law :

Rate = $k[A]^x[B]^y$

x and y indicate how sensitive the rate is to the change in concentration of A and B. Sum of x + y gives the overall order of a reaction. When a sequence of elementary reactions gives us the products, the reactions

are called complex reactions. Molecularity and order of an elementary reaction are same. Zero order reactions are relatively uncommon but they occur under special conditions. All natural and artificial radioactive decay of unstable nuclei take place by first order kinetics.

1. What is the effect of temperature on the rate constant of a reaction?
2. For a reaction $A + B \rightarrow$ Product, the rate law is given by, Rate = $k[A]^2[B]^2$. What is the order of the reactions?
3. How order and molecularity are different for complex reactions?
4. A first order reaction has a rate constant $2 \times 10^{-3}\ s^{-1}$. How long will 6 g if this reactant take to reduce to 2 g?

OR

4. The half life for radioactive decay of $^{14}C$ is 6930 years. An archaeological artifact containing wood had only 75% of the $^{14}C$ found in a living tree. Find the age of the sample

[log 4 = 0.6021, log 3 = 0.4771, log 2 = 0.3010, log 10 = 1]

**Section - E**

Q31. a) Vapour pressure of water at 293 K is 17.535 mmHg. Calculate the vapour pressure of water at 293K where 25g of glucose is dissolved is 450g of water. (Molar mass of Glucose = 180g/mol)

b) State Raoult's law - what type of deviation from Raoult's law is shown by a solution of chloroform and acetone and why?

OR

a) Calculate the boiling point of solution when 2g of $Na_2SO_4$ (M=142/g mol) was dissolved in 50g of water assuming $Na_2SO_4$ undergoes complete ionization (Kb for water = 0.52K kg/mol)

b) Define azeotropes? What type of azeotrope is formed by negative deviation from Raoult's law? Give an example.

Q32. a) The resistance of a conductivity are containing 0.001M KCl solution at 298K is 1500 ohm. What is the cell constant if conductivity of 0.001M KCl solution at 298K is $0.146 \times 10^{-3}$ $Scm^{-1}$.

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

OR

a) Define the following terms :

i) Limiting molar conductivity

ii) Fuel cell

b) The electrical resistance of a column of 0.05 mol/ L NaOH solution of diameter 1cm and length 50cm is $5.55 \times 10^3$ ohm. Calculate resistivity, conductivity and molar conductivity.

Q33. a) The conversion of molecule X to Y follows second order kinetics. If concentration of X increased to three times, how will it affect the rate of formation of Y?

b) The rate of the chemical reaction doubles for an increase of 10K is absolute temperature from 298K. Calculate Ea.

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### Section - A

Q1. An azeotropic mixture of two liquids has a boiling point higher than either of the two liquids when it

a) shows large negative deviation from Raoult's law
b) shows no deviation from Raoult's law
c) shows large positive deviation from Raoult's law
d) obeys Raoult's law

Q2. 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

Q3. 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 is boiling point

Q4. Zinc is coated over iron to prevent rusting of iron because

a) $E^0_{Zn^{2+}/Zn} = E^0_{Fe^{2+}/Fe}$ b) $E^0_{Zn^{2+}/Zn} < E^0_{Fe^{2+}/Fe}$ c) $E^0_{Zn^{2+}/Zn} > E^0_{Fe^{2+}/Fe}$ d) None of these

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) half-order reaction

Q6. The role of a catalyst is to change _____

a) gibbs energy of reaction b) enthalpy of reaction
c) activation energy of reaction d) equilibrium constant

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

a) Inter pair effect b) Completely filled 3d subshell
c) Completely filled 4s subshell d) Common ion effect

Q8. The most common and stable oxidation state of Lanthanoid is

a) + 2 b) + 3 c) + 4 d) + 6

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. When 1 mol $CrCl_3.6H_2O$ is treated with excess of $AgNO_3$, 3 mol of AgCl are obtained. The formula of the complex is:

a) $[CrCl_3(H_2O)_3].3H_2O$ b) $[CrCl_2(H_2O)_4]Cl.2H_2O$

c) $[CrCl(H_2O)_5]Cl_2.H_2O$ d) $[Cr(H_2O)_6]Cl_3$

Q11. The stabilization of coordination compounds due to chelation is called the chelate effect. Which of the following is the most stable complex species?

a) $[Fe(CO)_5]$ b) $[Fe(CN)_6]^{3-}$ c) $[Fe(C_2O_4)_3]^{3-}$ d) $[Fe(H_2O)_6]^{3+}$

Q12. The CFSE for octahedral $[CoCl_6]^{4-}$ is 18,000 $cm^{-1}$. The CFSE for tetrahedral $[CoCl_4]^{2-}$ will be

a) 18,000 $cm^{-1}$ b) 16,000 $cm^{-1}$ c) 8,000 $cm^{-1}$ d) 20,000 $cm^{-1}$

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d) Assertion (A) is incorrect, but Reason (R) is correct statement.

Q13. Assertion (A) : When NaCl is added to water a depression in freezing point is observed.

Reason (R) : The lowering of vapour pressure of a solution causes depression in freezing point.

Q14. Assertion (A) : The half life of a reaction is the time in which the concentration of the reactant is reduced to one half of its initial concentration.

Reason (R) : In first order kinetics when concentration of reactant is doubled, its half life is doubled.

Q15. Assertion (A) : Copper is a non-transition element.

Reason (R) : Copper has completely filled d-orbitals in its ground state.

Q16. Assertion (A) : Low spin tetrahedral complexes are rarely observed.

Reason (R) : Crystal field splitting energy is less than pairing energy for tetrahedral complexes.

**Section - B**

Q17. How much electricity in terms of Faraday is required to produce? (Atomic mass of Ca = 40 g/mol, Al = 27gm/mol)

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

b) 40.0 gm of Al from molten $Al_2O_3$

OR

Calculate the e.m.f. of the following cell at 298K

$Fe(s)\ l\ Fe^{+2}(0.01M) \parallel H^+(1M)\ l\ H_2(g)1\ bar\ Pt\ (s)$ given $E^0_{cell} = 0.44V$

Q18. What is the Lanthanoid contraction? What are the consequences of Lanthanoid contraction? (any two)

Q19. Give reason

a) The transition metals generally form coloured compounds

b) Transition metals are good catalysts

Q20. Write IUPAC names of

a) Potassium tetracyanidonickelate (I)

b) Pentaamminenitito – N – cobatt (III)

Q21. Draw the structures of optical isomers of

a) $[Cr(NH_3)_2Cl_2en]^+$ b) $[Cr(C_2O_4)_3]^{-3}$

B-2

## Section - C

Q22. State Henry's law. Write its application. What is the effect of temperature on solubility of gas in liquid?

Q23. Calculate the mole fraction of benzene in solution containing 30% by mass in $CCl_4$.

(Atomic mass of C = 14g/mol, H = 1g/mol, O = 16g/mol, Cl = 35.5g/mol)

Q24. a) Name the cell which
   i) is used in automobiles and invertors
   ii) does not give a steady potential and is used in transistors

b) Define specific conductance or conductivity

Q25. A first order reaction has rate constant $1.15 \times 10^{-3}\ s^{-1}$. How long will 5gm of this reactant take to reduce to 3gm. (Log 5/3 = 1.667)

Q26. Indicate the steps in the preparation of $K_2Cr_2O_7$ from chromite ore

Q27. a) Which ion amongst the following is colourless and why?

$Ti^{+4}$, $Cr^{+3}$, $V^{+3}$ (Atomic no. of Ti = 22, Cr = 24, V = 23)

b) Why is $Mn^{+2}$ much more resistant than $Fe^{+2}$ towards oxidation?

Q28. $[Cr(NH_3)_6]^{+3}$ is paramagnetic while $[Ni(CN)_4]^{-2}$ is diamagnetic. Explain why? (Atomic no. of Cr = 24 & Ni = 28)

OR

Give oxidation state, d-orbital occupation and co-ordination number of the central metal ion in the following complex

a) $k_3[Co(C_2O_4)_3]$ b) $[Mn(H_2O)_6]SO_4$

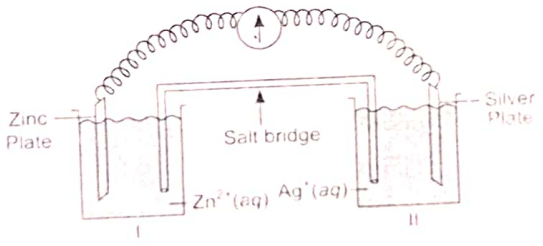
{Atomic no. of Co = 27 and Mn = 25}

## Section - D

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

Oxidation-reduction reactions are commonly known as redox reactions. They involve transfer of electrons from one species to another. In a spontaneous reaction, energy is released which can be used to do useful work. The reaction is split into two half reactions. Two different containers are used and a wire is used to drive the electrons from one side to the other and a Voltaic/Galvanic cell is created. It is an electrochemical cell that uses spontaneous redox reactions to generate electricity. A salt bridge also connects to the half cells. The reading of the voltmeter gives the cell voltage or cell potential or electromotive force. If E cell is positive the reaction is spontaneous and if it is negative the reaction is non-spontaneous and is referred to as electrolytic cell. Electrolysis refers to the decomposition of a substance by an electric current. One mole of electric charge when passed through a cell will discharge half a mole of a divalent metal ion such as $Cu^{2+}$. This was first formulated by Faraday in the form of laws of electrolysis.

The conductance of material is the property of materials due to which a material allows the flow of ions through itself and thus conducts electricity. Conductivity is represented by k and it depends upon nature and concentration of electrolyte, temperature etc. A more common term molar conductivity of a solution at a given concentration is conductance of the volume of solution containing one mole of electrolyte kept between two electrodes with the unit area of cross-section and distance of unit length. Limiting molar conductivity of weak electrolytes cannot be obtained graphically.



a) Is silver plate the anode or cathode?
b) What will happen if the salt bridge is removed?
c) (i) What will happen to the concentration of $Zn^{2+}$ and $Ag^{+}$ when $E_{cell} = 0$
(ii) Why does conductivity of a solution decreases with dilution?

OR

c) The molar conductivity of a 1.5M solution of an electrolyte is found to be 138.9 S $cm^2$ $mol^{-1}$. Calculate the conductivity of this solution.

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

The rate of reaction is sometimes altered by conditions. Consider a reaction between two substances when one reactant is present in large excess. During hydrolysis of 0.01 mol of ethyl acetate with 10 moles of water, in presence of $H^+$, the rate law was determined by taking conc. after 30 min and conc reduced from 0.85 to 0.80 in 30 min.

1. What are the molecularity and order of the reaction respectively?
2. What will be order of reaction if ester is hydrolysed by using NaOH?
3. What will be the rate constant of reaction on the basis of data given in the passage?
[Given: log 17 = 1.2304, log 16 = 1.2041]

OR

3. (i) The rate of reaction does not remain constant throughout the course of reaction? Give reason.
(ii) Write reaction for the above Psendo first order reaction. Also write rate law.

## SECTION -E

Q31. a) Differentiate between Ideal and Non-ideal solution.

b) 30gm of urea is desolved in 846gm of water. Calculate the Vapour pressure of solution. (V.P of pure water at 298K is 23.8mm Hg)

OR

a) Why the value of vant Hoff factor for ethanoic acid in benzene is close to 0.5 ?

b) Determine the Osmotic Pressure of a solution prepared by dissolving $2.32 \times 10^{-2}$ gm of $K_2SO_4$ in 2L R = 0.082L atm $k^{-1}$ $mol^{-1}$ (Molar mass of $K_2SO_4$ = 174g/mol)

Q32. a) State Kohleausch law of independent migration of ions why does the conductivity of a solution decreases with dilution.

b) Calculate the degree of dissociation ($\alpha$) of acetic acid if its molar conductivity ($\Lambda m$) is 39.05$cm^2$ $mol^{-1}$. Given $\lambda^0_{H^+} = 349.6\ Scm^2\ mol^{-1}$ $\lambda^0_{CH_3COO^-} = 40.9\ Scm^2\ mol^{-1}$

OR

a) Write the chemistry of recharging the lead storage battery, highlighting all the material that are involved during recharging.

b) Give 2 points of difference between electgrochemical cell and electrolytic cell.

Q33. a) Calculate the half life of a first order reaction from their rate constant given below:

i) 2 $min^{-1}$ ii) 4 $years^{-1}$

b) What happens to the rate constant (K) and activation energy (Ea) as the temperature of chemical reaction is increased. Justify.

c) For the reaction $A + B \rightarrow P$

The rate law is given by $r = K\,[A]^{1/2}\,[B]^2$

What is the order of reaction?