

Instructions to Candidates

- You are allowed additional 15 minutes for only reading the question paper.
- You must NOT start writing during the reading time.
- It is divided into four sections and has 21 questions in all.
- All questions are compulsory. Answer all questions.
- Section A has fourteen subparts. Each question carries 1 mark.
- While attempting Multiple Choice Questions in Section A, you are required to write only ONE option as the answer.
- Section B has ten questions. Each question carries 2 marks.
- Section C has seven questions. Each question carries 3 marks.
- Section D has three questions. Each question carries 5 marks.
- internal choices have been provided in one question each in Sections B, C and D.
- The intended marks for questions are given in brackets [].
- All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.
- Balanced equations must be given wherever possible and diagrams where they are helpful.
- When solving numerical problems, all essential workings must be shown.
- In working out problems, use the following data:

Gas constant $R = 1.987 \text{ cal deg}^{-1} \text{ mol}^{-1} = 8.314 \text{ JK}^{-1} \text{ mol}^{-1} = 0.0821 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$,
 $1 \text{ atm} = 1 \text{ dm}^3 \text{ atm} = 101.3 \text{ J}$.

1 Faraday = 96500 coulombs. Avogadro's number = 6.023×10^{23} .

SECTION-A [14 MARKS]**Question 1.**

(A) Fill in the blanks by choosing the appropriate word/words from those given in the brackets: $[4 \times 1 = 4]$

(salicylaldehyde, higher, Kolbe's, zero, lower, $(n-1)d^{1-10}$, salicylic acid, tetrahedral, square planar, Reimer-Tiemann, ns^{1-2} , four)

- (i) A redox reaction is feasible when the substance having _____ reduction potential gets reduced and the one having _____ reduction potential gets oxidized.
- (ii) The complex $[\text{Ni}(\text{CO})_4]$ is _____ in shape and has _____ number of unpaired electrons.
- (iii) When chloroform is heated with phenol and NaOH at 340K, _____ is obtained as the major product and the reaction is called _____ reaction.
- (iv) The variation and magnitude of oxidation state in coordination compounds is due to the participation of inner _____ electrons in addition to outer _____ electrons.

(B) Select and write the correct alternative from the choices given below:

[7×1=7]

- (i) The correct order of the increasing acidic strength of phenols, water and alcohols is:
- alcohols < phenols < water
 - phenols < alcohols < water
 - phenols < water < alcohols
 - alcohols < water < phenols
- (ii) $\text{PtCl}_4 \cdot 6\text{H}_2\text{O}$ can exist as a hydrated complex. One molal aqueous solution of the salt recorded a decrease in freezing point of 3.72°C . If the salt is assumed to be 100% ionized in solution and k_f for water is 1.86K kg mol^{-1} , the molecular formula of complex is likely to be:
- $[\text{Pt}(\text{H}_2\text{O})_6]\text{Cl}_4$
 - $[\text{Pt}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}_2 \cdot 2\text{H}_2\text{O}$
 - $[\text{Pt}(\text{H}_2\text{O})_3\text{Cl}_3]\text{Cl} \cdot 3\text{H}_2\text{O}$
 - $[\text{Pt}(\text{H}_2\text{O})_2\text{Cl}_4] \cdot 4\text{H}_2\text{O}$
- (iii) Acid catalysed addition of water to form alkenes follow Markownikoff's rule. Thus, if propene is treated with acidified water, the major product would be :
- Propan-1-ol
 - Propan-2-ol
 - acetaldehyde
 - acetone
- (iv) The relation between the osmotic pressure of three different 1M aqueous solutions A, B, C is such that $\pi_B < \pi_C$, $\pi_C > \pi_A$, $\pi_A > \pi_B$. Which of these is likely to be the aqueous solution of glucose, potassium ferrocyanide, benzoic acid.
- C- glucose, B- potassium ferrocyanide, A- benzoic acid
 - B- glucose, C- potassium ferrocyanide, A- benzoic acid
 - A- glucose, C- benzoic acid, B- potassium ferrocyanide
 - A- glucose, B- benzoic acid, C- potassium ferrocyanide
- (v) Lanthanoid contraction is responsible for which of the following facts:
- (P) Zr and Hf belong to the same period.
(Q) Zr and Hf have the same atomic radii.
(R) $\text{La}(\text{OH})_3$ is most basic while $\text{Lu}(\text{OH})_3$ is least basic.
(S) Zn is not considered as a transition element.
- only P and Q
 - only Q and R
 - only S
 - only Q
- (vi) Assertion: The rate constant does not depend upon the initial concentration of the reactant.
Reason: The value of rate constant changes on changing the temperature of the reaction.
- Both assertion and reason are true and reason is the correct explanation of assertion.
 - Both assertion and reason are true but reason is not the correct explanation for assertion.
 - Assertion is true but reason is false.
 - Both assertion and reason are false.

(vii) Assertion: Haloalkanes on being treated with alcoholic solution of AgCN give alkyl isocyanides as the major product.

Reason: AgCN is a covalent compound and CN^- is an ambident nucleophile.

- (a) Both assertion and reason are true and reason is the correct explanation of assertion.
- (b) Both assertion and reason are true but reason is not the correct explanation for assertion.
- (c) Assertion is true but reason is false.
- (d) Both assertion and reason are false.

(C) Read the passage given below carefully and answer the questions that follow.

[3×1=3]

Lead storage cell is the most commonly used battery in automobiles. Each battery consists of a number of voltaic cells connected in series to get a voltage of 6 V to 12V. The cell can be recharged by passing the electric current of suitable voltage in opposite direction.

- (i) Identify anode and cathode respectively in the above cell.
- (ii) Why salt bridge is not needed in the above cell?
- (iii) Indicate the condition when the above battery needs recharging.

SECTION-B [20 MARKS]

Question 2.

[2]

Arrange the following compounds in increasing order of the property indicated against each. Give reasons for your answers.

- (i) $(\text{CH}_3)_2\text{CHOH}$, $(\text{CH}_3)_3\text{COH}$, $\text{CH}_3\text{CH}_2\text{OH}$ (order of reactivity towards nucleophilic substitution)
- (ii) $\text{CH}_3\text{CH}_2\text{OH}$, $\text{HO-CH}_2\text{-CH}_2\text{-OH}$, $\text{CH}_3\text{CH}_2\text{Cl}$ (Boiling point)

Question 3.

[2]

Riya wanted her silver bangle to be electroplated with gold. She takes it to the jeweller who electroplates it by passing 2A current for 1 hour using 1M AuCl_3 solution. The jeweller states that he has electroplated 10g of gold and charges accordingly. Evaluate the jeweller's statement.

(At. wt. of Au= 197)

Question 4.

[2]

Phenol when treated with Br_2 in CS_2 gives mono- substituted products while when treated with Br_2 (aq) gives a tri-substituted product. Explain and give relevant equations also.

Question 5.

[2]

John was performing an experiment on chemical kinetics having reactants A and B such that when he doubled the concentration of both A and B, the rate of reaction increased by 8 times. However, on doubling the concentration of only B, the reaction rate was doubled. John concluded that the rate law should be $r = k[\text{A}][\text{B}]^2$. Analyse his result and give the correct rate law if he is wrong.

Question 6.

[2]

Convert chlorobenzene to toluene using Na metal and write the name of the reaction involved.

Question 7.

[2]

Arjun noticed that the blue colour of crystalline CuSO_4 fades on heating and finally anhydrous CuSO_4 is obtained which is colourless. Explain his observation in the light of crystal field theory.

Question 8.

[2]

(i) How is phenol converted to:

- (a) an azo dye
- (b) an explosive

OR

(ii) An organic compound (A) having molecular formula C_3H_6O on treatment with Grignard reagent followed by hydrolysis gave (B). (B) when heated with iodine and caustic alkali gave a yellow crystalline solid (C) and sodium salt of propanoic acid. Identify A, B, C and Grignard reagent.

Question 9.

[2]

Yash measures the conductivity of two different solutions of 1M Ethanoic acid and 1M HCl each at $25^\circ C$.

- (a) Will he observe the same conductivity value for both the solutions? Justify your answer.
- (b) What will be the effect on conductivities when he keeps on diluting the solutions? Explain with the help of a graph.

Question 10.

[2]

Convert isopropyl alcohol to t-butyl alcohol using Grignard reagent.

Question 11.

[2]

Write balanced chemical equations:

Bottles containing C_6H_5I and $C_6H_5CH_2I$ lost their original labels. They were taken separately in two different test tubes A and B respectively. Both the test tubes were treated with NaOH solution followed by the addition of dil. HNO_3 and $AgNO_3$ solutions. What will you observe and why?

SECTION-C [21 MARKS]**Question 12.**

[3]

1.22 g of benzoic acid (C_6H_5COOH) is added separately in 100 g of acetone and 100 g of benzene. The boiling point of the solution in acetone increases by $0.17^\circ C$ while that in benzene increases by $0.13^\circ C$. Calculate the molecular mass of benzoic acid in both the cases and justify your result. [$k_b(\text{acetone}) = 1.7 K kg mol^{-1}$ and $k_b(\text{benzene}) = 2.6 K kg mol^{-1}$].

Question 13.

[3]

The product obtained on acid catalysed dehydration of alcohols vary according to the experimental conditions. Support the above statement by giving appropriate reactions and mechanisms involved.

Question 14.

[3]

(i) Write the structural formula and IUPAC name of the complex $PtCl_4 \cdot 2KCl$. This complex does not give ppt. with silver nitrate solution. Why?

OR

(ii) $[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic while $[Fe(CN_6)]^{3-}$ is weakly paramagnetic. Explain on the basis of VBT.

Question 15.

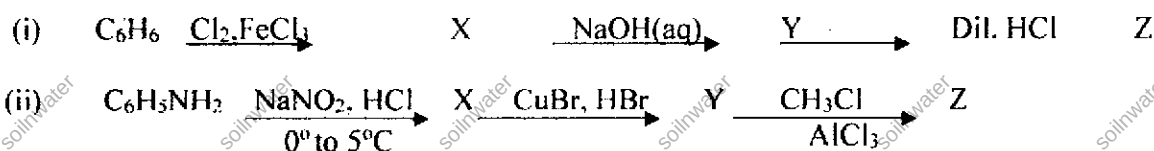
[3]

Two students use same stock solution of $ZnSO_4$ and a solution of $CuSO_4$. The e.m.f of one cell is 0.03V higher than the other. The concentration of $CuSO_4$ in the cell with higher e.m.f value is 0.5M. Find out the concentration of $CuSO_4$ in the other cell.

Question 16.

[3]

Identify X, Y, Z in the following reactions:

**Question 17.**

[3]

Pyrolusite on heating with KOH in the presence of air gives dark green compound A. The solution of A on treatment with O_3 gives a purple coloured compound B, which gives the following reactions:

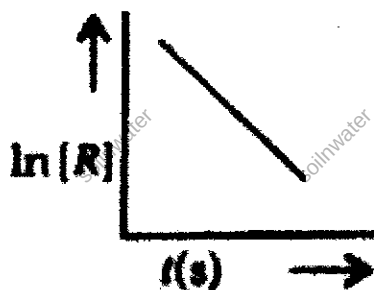
- (i) KI on reaction with alkaline solution of B changes into a compound C.
(ii) The colour of the compound B disappears on treatment with acidic solution of FeSO_4 .

Identify A, B, C and give balanced chemical equations to support your answer.

Question 18.

[3]

For a certain chemical reaction, variation in the concentration, $\ln[R]$ vs time(s) plot is shown below:

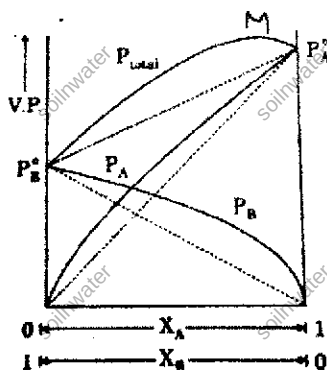


- (i) What is the order of the reaction? Justify your answer.
(ii) If initial concentration for this reaction becomes half, how will $t_{1/2}$ vary?
(iii) Draw the plot of $\log [R]_0/[R]$ vs time (s).

SECTION-D [15 MARKS]**Question 19.**

[5]

- (i) (a) Consider a binary solution of two volatile components A and B whose p-x graph is shown below. Answer the questions that follow the graph:



- (b) Compare the vapour pressure of solution at M with the vapour pressure of pure components.
(c) What kind of energy change will be observed while preparing the solution.
(d) The initial volume of components A and B is p ml and q ml respectively. Why is the volume of above solution greater than (p+q) ml?
(e) If the solution distils over point M, what is the composition of distillate with respect to the solution.

(f) Draw a T-x graph for the same solution.

OR

- (ii) (a) A motor vehicle radiator was filled with 8L of water to which 2L of methyl alcohol (density 0.8 g/ml) were added. What is the lowest temperature at which the vehicle can be parked outdoors without danger that water in the radiator will freeze? K_f of water is 1.86 K m^{-1} .

(b) Ravi visited Kedar Nath during which he was unable to think and reason out clearly. Name the condition from which he was suffering. Give an explanation for the same.

Question 20.

[5]

(a) A sweet smelling organic compound (A) is slowly oxidized by air in the presence of light to a highly poisonous gas. On warming with silver powder it forms a gaseous substance (B) which is also formed by the action of calcium carbide on water. Identify A and B and write the chemical reactions involved.

(b) What happens when:

(i) Iodoform is heated with caustic potash.

(ii) Chlorobenzene is heated with aqueous ammonia in the presence of Cu_2O at 475 K and under high pressure.

Question 21.

[5]

(a) How would you account for the following:

(i) Transition elements act as good catalysts.

(ii) There is a greater range of oxidation states among the actinoids as compared to lanthanoids.

(iii) Ce^{4+} has a tendency to act as an oxidizing agent (At. No. 58)

(b) Write balanced chemical equation for the reaction between acidified $\text{K}_2\text{Cr}_2\text{O}_7$ and H_2S . Also, state the relation between molecular wt. and equivalent wt. of $\text{K}_2\text{Cr}_2\text{O}_7$ in this reaction.