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Candidates must write the Set No. on the title page of the answer book.

DAV PUBLIC SCHOOLS, ODISHA ZONE
HALF YEARLY EXAMINATION, 2023-24

- Please check that this question paper contains **07** printed pages.
- Set number given on the right hand side of the question paper should be written on the title page of the answer book by the candidate.
- Check that this question paper contains **33** questions.
- Write down the Serial Number of the question in the left side of the margin before attempting it.
- 15 minutes time has been allotted to read this question paper. The question paper will be distributed 15 minutes prior to the commencement of the examination. The students will read the question paper only and will not write any answer on the answer script during this period.

CLASS- XII**SUB: CHEMISTRY (043)****Time: 3 Hours****Maximum Marks: 70*****General Instructions:***

Read the following instructions carefully.

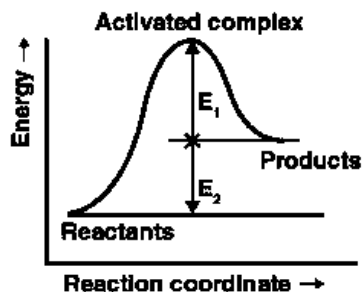
- (a) There are 33 questions in this question paper with internal choice.
- (b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
- (c) SECTION B consists of 5 short answer questions carrying 2 marks each.
- (d) SECTION C consists of 7 short answer questions carrying 3 marks each.
- (e) SECTION D consists of 2 case- based questions carrying 4 marks each.
- (f) SECTION E consists of 3 long answer questions carrying 5 marks each.
- (g) All questions are compulsory.
- (h) Use of log tables and calculators is not allowed.

SECTION A

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. The value of K_H (Henry's law constant) for the given gases in water at 293K are: 1
 He- 144.97 k bar, H_2 - 69.16 k bar, N_2 - 76.45 k bar, O_2 - 34.86 k bar,
 Which gas has the lowest solubility in water?
 a) He b) H_2 c) N_2 d) O_2

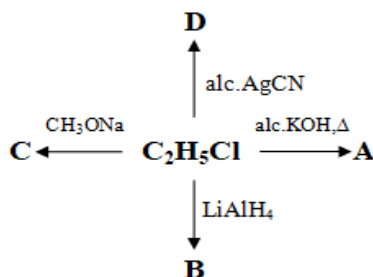
2. Consider the following figure and mark the correct option. 1



- a) The activation energy of forward reaction is $E_1 + E_2$ and the product is less stable than reactant.
 b) The activation energy of forward reaction is $E_1 + E_2$ and product is more stable than reactant.
 c) The activation energy of both forward and backward reaction is $E_1 + E_2$ and reactant is more stable than the product.
 d) The activation energy of the backward reaction is E_1 and the product is more stable than reactant.
3. Which among the following elements does not show variable oxidation state? 1
 a) Sc b) V c) Fe d) Hg
4. Identify the secondary allylic alcohol from the following: 1
 a) But-3-en-2-ol b) But-2-en-2-ol c) Prop-2-enol d) Butan-2-ol
5. For the reaction $A+2B \rightarrow 3C+2D$ the rate of disappearance of B is $1 \times 10^{-2} \text{ molL}^{-1} \text{ s}^{-1}$. What will be rate of change in concentration of A? 1
 a) $0.005 \text{ molL}^{-1} \text{ s}^{-1}$ b) $0.05 \text{ molL}^{-1} \text{ s}^{-1}$ c) $0.5 \text{ molL}^{-1} \text{ s}^{-1}$ d) $5 \text{ molL}^{-1} \text{ s}^{-1}$
6. Transition elements form alloys easily because they have 1
 a) same atomic number b) same electronic configuration
 c) nearly same atomic size d) paired electrons
7. A reaction in which reactant (R) is converted into product (P) follows second order kinetics. If concentration of R is increased by four times, what will be the increase in the rate of formation of P? 1
 a) 9 times b) 4 times c) 16 times d) 8 times
8. The CFSE for $[\text{CoCl}_6]^{4-}$ is $18,000 \text{ cm}^{-1}$. The CFSE for $[\text{CoCl}_4]^{2-}$ will be 1
 a) $9,000 \text{ cm}^{-1}$ b) $16,000 \text{ cm}^{-1}$ c) $8,000 \text{ cm}^{-1}$ d) $20,000 \text{ cm}^{-1}$
9. When KMnO_4 acts as oxidising agent in alkaline medium, the oxidation number of Mn decreases by 1
 a) 1 b) 2 c) 3 d) 5
10. Which among the following alkenes produces tertiary butyl alcohol on acid hydration? 1
 a) 2-Methylpropene b) But-2-ene c) But-1-ene d) Prop-1-ene

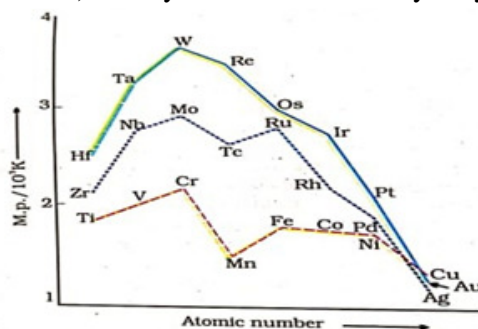
17. Calculate the emf of the cell in which the following reaction takes place 2

$$\text{Ni(s)} + 2\text{Ag}^+(0.002\text{M}) \rightarrow \text{Ni}^{2+}(0.160\text{M}) + 2\text{Ag(s)}$$
 (Given that $E^\circ_{\text{cell}} = 1.05\text{ V}$, $\log 2 = 0.301$)
18. Complete the following chemical equations: 2
 a) $\text{Cr}_2\text{O}_7^{2-} + \text{Fe}^{2+} + \text{H}^+ \rightarrow$
 b) $\text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} + \text{H}^+ \rightarrow$
19. Identify A, B, C, D 2



20. Suggest a chemical test to distinguish between 2
 a) Phenol and Ethanol b) n-Butyl alcohol and tertiary butyl alcohol

21. 2



Trends in melting points of transition elements are depicted in the above figure.

Explain the following observations.

- a) Transition metals have high enthalpy of atomisation.
 b) The melting points of most of the transition metals except Zn, Cd, and Hg are above 1173K.

OR

- a) Cr^{2+} is stronger reducing agent than Fe^{2+} . Explain.
 b) Calculate the magnetic moment of a divalent cation ($Z = 27$).

SECTION C

This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22. a) State Henry's law. 3
 b) Why is the freezing point increased by addition of HgI_2 to an aqueous KI solution?
 c) Chemists prefer to refer concentration of solution in terms of molality instead of molarity. Justify.
23. a) How much electricity in terms of Faraday is required to produce 40g of Al from molten Al_2O_3 ? (Atomic mass of Al = 27 u). 3
 b) Predict the products of electrolysis of an aqueous solution of CuBr_2 using platinum electrode.
 c) Calculate the Λ^0 for NaBr, if the limiting molar conductivities Λ^0 for NaCl, KBr and KCl are 126, 152 and 150 $\text{S cm}^2 \text{ mol}^{-1}$ respectively.
24. a) Write the IUPAC name of complex $[\text{Cr}(\text{en})_2(\text{OH})_2]\text{Cl}$. 3

- b) A solution of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ is green but a solution of $[\text{Ni}(\text{CN})_4]^{2-}$ is colourless. Explain.
- c) Write the electronic configuration of d^4 on the basis of crystal field theory when $\Delta_o > P$.
25. a) The rate constant for the first order decomposition of H_2O_2 is given by the following 3
equation: $\log k = 14.2 - \frac{1 \times 10^4}{T} \text{ K}$. Calculate E_a for this reaction and rate constant if its half life period is 200 minutes. $[R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}]$
- b) For which type of reactions, order and molecularity have the same value?
26. Attempt **any three** of the following: 3
- a) **Convert:** Aniline to Bromobenzene
- b) Among the isomers of pentane (C_5H_{12}), write the one which on photochemical chlorination yields a single monochloride.
- c) The presence of nitro group ($-\text{NO}_2$) at o/p positions increases the reactivity of haloarenes towards nucleophilic substitution reactions. Justify.
- d) Write the IUPAC name of DDT.
27. a) Give an example of a pseudo first order reaction. 3
b) A reaction is first order in A and second order in B. Write the differential rate equation.
c) What is the molecularity of the reaction: $\text{Cl}(\text{g}) \rightarrow \frac{1}{2} \text{Cl}_2(\text{g})$?
28. The electrical resistance of a column of 0.05 mol L^{-1} NaOH solution of diameter 1 cm and length 50 cm is $5.55 \times 10^3 \text{ ohm}$. Calculate its resistivity, conductivity and molar conductivity. 3

SECTION D

The following questions are case -based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

29. The substitution reaction of alkyl halide mainly occurs by $\text{S}_{\text{N}}1$ or $\text{S}_{\text{N}}2$ mechanism. Whatever mechanism alkyl halides follow for the substitution reaction to occur, the polarity of the carbon-halogen bond is responsible for these substitution reactions. The rate of $\text{S}_{\text{N}}1$ reactions are governed by the stability of carbocation whereas for $\text{S}_{\text{N}}2$ reactions, steric factor is the deciding factor. If the starting material is a chiral compound, we may end up with an inverted product or racemic mixture depending upon the type of mechanism followed by alkyl halide. Cleavage of ethers with HI is also governed by steric factor and stability of carbocation, which indicates that in organic chemistry, these two major factors help us in deciding the kind of product formed. Elimination and substitution reactions are two types of chemical reactions mainly found in organic chemistry. The key difference between elimination and substitution reaction can be best explained by using their mechanism. In elimination reaction, rearrangement of previous bonds occurs after the reaction, whereas substitution reaction replaces a leaving group with a nucleophile. These two reactions compete with each other and are influenced by several other factors. Those conditions vary from one reaction to another. 4

Answer the following questions:

- a) Predict the stereochemistry of the product formed if an optically active alkyl halide undergoes substitution reaction by $\text{S}_{\text{N}}2$ mechanism.
- b) Write the structures of the products formed, when anisole is treated with HI.
- c) Predict the major product formed when 2-Bromobutane reacts with alcoholic KOH. Write the equation involved.

OR

Following compounds are given:

2-Bromopentane, 2-Bromo-2-methylbutane, 1-Bromopentane.

- Write the compound which is most reactive towards S_N2 reaction.
- Write the compound which is optically active.

30. A device which is used to convert chemical energy produced in a spontaneous redox reaction into electrical energy is called electrochemical cell or Galvanic Cell. Galvanic cell consists of two half cells and the reaction occurring in half cells are called half cell reactions. Each half cell consists of metallic electrode dipped in an electrolyte. The half cell in which oxidation occurs is called oxidation half cell and the reaction taking place is called oxidation half cell reaction. The half cell in which reduction occurs is called reduction half cell and the reaction taking place is called reduction half cell reaction. The electrode where oxidation occurs is called anode and the electrode where reduction occurs is called cathode. The potential difference between these two electrodes is called the cell potential and is responsible for the flow of electrons in the circuit. The two half cells are joined by a salt bridge internally that maintains electrical neutrality of the two half cells and complete the electrical circuit by allowing the ions to flow. The following fig. shows a diagram of a galvanic cell. 4

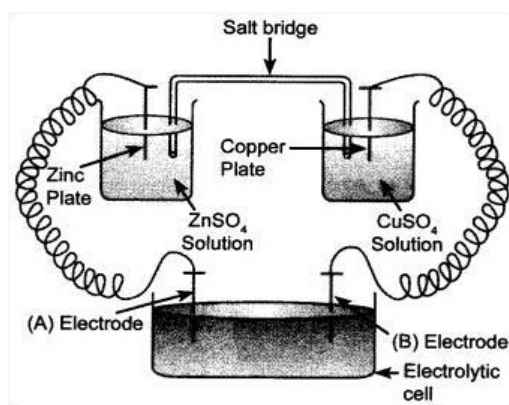
Answer the following questions:

- Depict the galvanic cell given in the fig.
- What happens when the salt bridge is removed?

OR

How does the cell behave, when an opposing potential of 1.5V is applied to the cell?

- A solution of metal salt was electrolyzed for 15 minutes, with a current of 1.5A. The mass of a metal deposited was 0.000783kg. Calculate the equivalent mass of the metal.



SECTION E

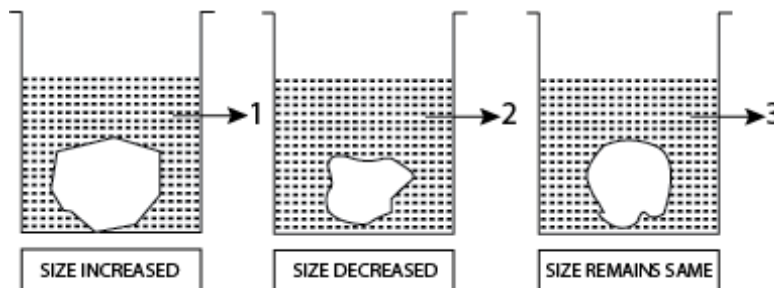
The following questions are long answer type and carry 5 marks each. All questions have an internal choice.

31. a) Account for the following: 5
- An increase in temperature is observed on mixing chloroform and acetone.
 - The tanks used by scuba divers are filled with air diluted with helium.
 - Measurement of osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.
- b) When 2.56 g of sulphur was dissolved in 100 g of CS_2 , its freezing point is lowered by 0.383 K. Calculate the formula of sulphur. (K_f for $CS_2 = 3.83 \text{ K kg mol}^{-1}$, Atomic mass of Sulphur = 32 g mol^{-1}).

OR

A candidate in order to study the process of osmosis has taken 3 potato cubes and puts them in 3 different beakers containing 3 different solutions. After 24 hours, in the first beaker the potato cube

increased in size, in the second beaker the potato cube decreased in size and in the third beaker there was no change in the size of the potato cube. The following diagram shows the result of the same experiment.



- a) i) Name the type of the solutions used in **beakers 1 and 2**.
 ii) In **beaker 3** the size of the potato cube remains the same. Explain the reason briefly.
- b) i) A 0.01 m aqueous solution of AlCl_3 freezes at -0.068°C . Calculate the percentage of dissociation of AlCl_3 . [Given : K_f for Water = $1.86\text{ K kg mol}^{-1}$]
 ii) Why sodium chloride is sprinkled on roads to clear snow in hilly areas?

32. Attempt any five of the following:

5

- a) Using valence bond theory, predict the hybridisation and magnetic character of the complex $[\text{Fe}(\text{CN})_6]^{4-}$. (Atomic no. of Fe = 26)
- b) When a coordination compound $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ is mixed with AgNO_3 , two moles of AgCl are precipitated per mole of the compound. What is the structural formula of the coordination compound?
- c) Does ionization isomer for the following compound exist? Justify your answer.
 $\text{Hg}[\text{Co}(\text{SCN})_4]$
- d) $[\text{NiCl}_4]^{2-}$ paramagnetic while $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic. Explain.
 (Atomic no. of Ni = 28)
- e) Arrange the following complexes in the decreasing order of conductivity of their solution: $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$, $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$, $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$, $[\text{Cr}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$.
- f) Which geometrical isomer of $[\text{CoCl}_2(\text{en})_2]^+$ is optically inactive & why?
- g) Is the central metal atom in coordination complexes a Lewis acid or a Lewis base? Explain.

33. a) An alcohol A ($\text{C}_4\text{H}_{10}\text{O}$) on oxidation with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ gives carboxylic acid

5

- 'B'** ($\text{C}_4\text{H}_8\text{O}_2$). Compound 'A' when dehydrated with conc. H_2SO_4 at 443 K gives compound 'C'. Treatment of 'C' with aqueous H_2SO_4 gives compound 'D' ($\text{C}_4\text{H}_{10}\text{O}$) which is an isomer of 'A'. Compound 'D' is resistant to oxidation but compound 'A' can be easily oxidized. Identify A, B, C and D and write the equations for the reactions involved.
- b) What is denaturation of alcohol?

OR

a) Write notes on

- i) Kolbe's reaction
 ii) Hydroboration oxidation reaction
- b) Identify the product and predict a suitable mechanism for the given reaction.

