Roll No. ☐☐☐☐☐☐☐

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. Which pair from the following will **not** form an ideal solution?   1
   a) $CCl_4 + SiCl_4$ b) $H_2O + C_4H_9OH$ c) $C_2H_5Br + C_2H_5I$ d) $C_6H_{14} + C_7H_{16}$

2. The plot that represents the zero order reaction is :   1

3. A larger number of oxidation states are exhibited by the actinides than those by the lanthanides. The main reason being: 1
   a) more reactive nature of the actinides than the lanthanides.
   b) 4f orbitals are more diffused than the 5f orbitals.
   c) lesser energy difference between 5f and 6d orbitals than between 4f and 5d orbitals.
   d) more energy difference between 5f and 6d orbitals than between 4f and 5d orbitals.

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 $1\times10^{-2}\,molL^{-1}s^{-1}$. What will be rate of change in concentration of A ?   1
   a) $0.005\,molL^{-1}s^{-1}$ b) $0.05\,molL^{-1}s^{-1}$ c) $0.5\,molL^{-1}s^{-1}$ d) $5\,molL^{-1}s^{-1}$

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. If the initial concentration is reduced to ¼ th in a zero order reaction, then the time taken for half of the reaction to complete: 1
    a) remains the same   b) becomes 4 times   c) becomes one-fourth   d) doubles

8. The CFSE for $[CoCl_6]^{4-}$ is $18,000cm^{-1}$. The CFSE for $[CoCl_4]^{2-}$ will be   1
   a) $9,000\ cm^{-1}$ b) $16,000\ cm^{-1}$ c) $8,000\ cm^{-1}$ d) $20,000\ cm^{-1}$

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. The major product of acid catalysed dehydration of 2-Methylcyclohexanol is   1
    a) 1-Methylcyclohexene   b) 2-Methylcyclohexene
    c) 2-Methylcyclohexene   d) 1-Methylcyclohexene

11. The correct order of decreasing second ionization enthalpy of Ti (22), V (23), Cr (24) and Mn (25) is   1
    a) Cr > Mn > V > Ti   b) V > Mn > Cr > Ti
    c) Mn > Cr > Ti >V   d) Ti > V > Cr >Mn

12. Cumene hydroperoxide on hydrolysis with dilute H_2SO_4 gives   1
    a) alcohol and phenol
    b) only phenol
    c) phenol and acetone
    d) alcohol and acetone

13. **Given below are two statements labelled as Assertion (A) and Reason (R)**   1

    Assertion (A): Azeotropic mixtures are formed only by non-ideal solutions and they may have boiling points either greater than both the components or less than both the components.

    Reason(R): The composition of the vapour phase is same as that of the liquid phase of an azeotropic mixture.

    Select the most appropriate answer from the options given below:

    (a) Both A and R are true and R is the correct explanation of A

    (b) Both A and R are true but R is not the correct explanation of A.

    (c) A is true but R is false.

    (d) A is false but R is true.

14. **Given below are two statements labelled as Assertion (A) and Reason (R)**   1

    Assertion(A): The molecularity of the reaction $H_2+Br_2 \rightarrow 2HBr$ is 2.

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

    Select the most appropriate answer from the options given below:

    (a) Both A and R are true and R is the correct explanation of A

    (b) Both A and R are true but R is not the correct explanation of A.

    (c) A is true but R is false.

    (d) A is false but R is true.

15. **Given below are two statements labelled as Assertion (A) and Reason (R)**   1

    Assertion (A): The purple colour of $KMnO_4$ is due to the charge transfer transition.

    Reason (R): The intense colour, in most of the transition metal complexes is due to d-d transition.

    Select the most appropriate answer from the options given below:

    (a) Both A and R are true and R is the correct explanation of A

    (b) Both A and R are true but R is not the correct explanation of A.

    (c) A is true but R is false.

    (d) A is false but R is true.

16. **Given below are two statements labelled as Assertion (A) and Reason (R)**   1

    Assertion (A): 3^0 alkyl halide are most reactive towards the S_N1 reaction.

    Reason (R): In S_N1 reaction, the rate of reaction depends only on the concentration of alkyl halide.

    Select the most appropriate answer from the options given below:

    (a) Both A and R are true and R is the correct explanation of A

    (b) Both A and R are true but R is not the correct explanation of A.

    (c) A is true but R is false.

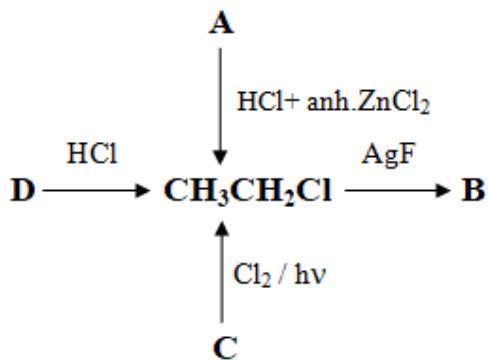   (d) A is false but R is true.

SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. Calculate the potential of hydrogen electrode in contact with a solution whose pH is 10.   **2**

18. Complete the following chemical equations: **2**

    a) $Cr_2O_7^{2-} + Fe^{2+} + H^+ \rightarrow$

    b) $MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow$
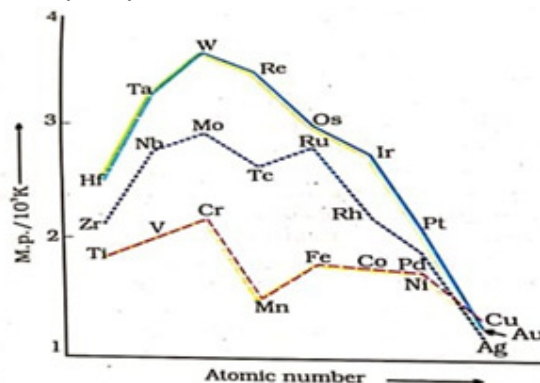
19. Identify **A, B, C, D**   **2**

$$A$$
$$\downarrow HCl + anh.ZnCl_2$$
$$D \xrightarrow{HCl} CH_3CH_2Cl \xrightarrow{AgF} B$$
$$\uparrow Cl_2 / h\nu$$
$$C$$

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   **3**
Al_2O_3? (Atomic mass of Al = 27 u).
b) Predict the products of electrolysis of an aqueous solution of $CuBr_2$ with using platinum electrode.
c) Calculate the $\wedge^0$ for NaBr if the limiting molar conductivities $\wedge^0$ for NaCl, KBr and KCl are 126, 152 and 150 S cm^2 mol^{-1} respectively.

24. a) Write the formulae of the following compound :   **3**
   Pentaamminecarbonatocobalt (III) chloride

b) $[Ti(H_2O)_6]^{3+}$ becomes colourless on heating. Explain.

c) Write the electronic configuration of d^6 on the basis of crystal field theory when $\Delta_o < P$.

25. Sucrose decomposes in acid solution into glucose and fructose according to the first order   **3**
rate law, with $t_{1/2}$ = 3.00 hours. What fraction of sample of sucrose remains after 8 hours?
(antilog 0.8024 = 6.345)

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 ($-NO_2$) 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: $Cl(g) \rightarrow \frac{1}{2} Cl_2(g)$?

28. The electrical resistance of a column of 0.05 $molL^{-1}$ NaOH solution of diameter 1 cm and   **3**
length 50 cm is 5.55 x 10^3 ohm. Calculate its resistivity, conductivity and molar conductivity.

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 S_N1 or S_N2 mechanism. Whatever   **4**
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 S_N1 reactions
are governed by the stability of carbocation whereas for S_N2 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.

Answer the following questions:

a) Predict the stereochemistry of the product formed if an optically active alkyl halide
undergoes substitution reaction by S_N2 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.

a) Write the compound which is most reactive towards S_N2 reaction.

b) Write the compound which is optically active.

30. Battery or cells are referred to as the parallel combination of electrochemical cells. The major **4** difference between a primary cell and the secondary cell is that primary cells are the ones that cannot be charged but secondary cells are the ones that are rechargeable. Primary cells have high density and get discharged slowly. Since there is no fluid inside these cells they are also known as dry cells. The internal resistance is high and the chemical reaction is irreversible. Its initial cost is cheap and also primary cells are easy to use. Secondary cells have low energy density and are made of molten salts and wet cells. The internal resistance is low and the chemical reaction is reversible. Its initial cost is high and is a little complicated to use when compared to the primary cell.
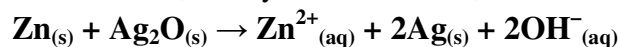
Answer the following questions:

a) Write the overall cell reaction when lead storage battery is in use.

OR

Write the advantage of mercury cell over dry cell.

b) Define fuel cell and write any one of its advantages.

c) In the button cell, widely used in watches, the following reaction takes place

$$Zn_{(s)} + Ag_2O_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2Ag_{(s)} + 2OH^-_{(aq)}$$

Determine E^0_{cell} and ΔG^0 for the reaction.

[Given $E^0_{(Ag+/Ag)}$ = +0.80V, $E^0_{(Zn2+/Zn)}$ = -0.76 V]

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**

    i) An increase in temperature is observed on mixing chloroform and acetone.

    ii) The tanks used by scuba divers are filled with air diluted with helium.

    iii) 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 K kg mol^{-1}, Atomic mass of Sulphur = 32 g mol^{-1}).

OR

    a) 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.

| SIZE INCREASED | SIZE DECREASED | SIZE REMAINS SAME |
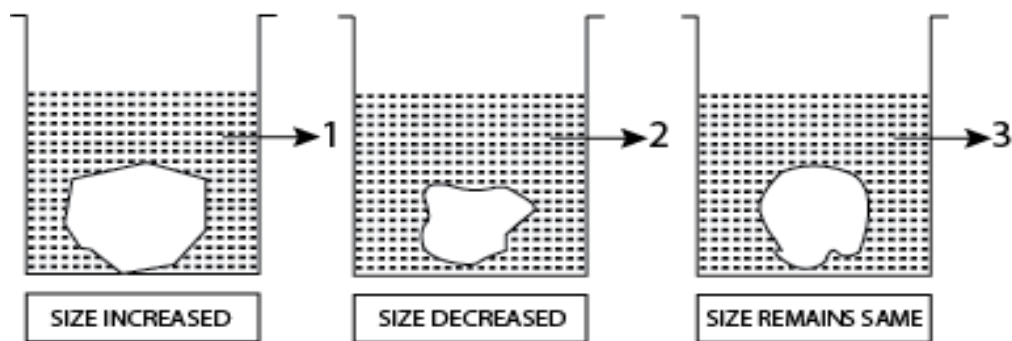
i) Name the type of the solutions used in **beakers 1 and 2.**

ii) In **beaker 3** the size of the potato cube remains the same. Explain the reason in brief.

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 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:

a) Using valence bond theory, predict the hybridisation and magnetic character of the complex $[Fe(CN)_6]^{4-}$. (Atomic no. of Fe = 26)

b) When a coordination compound **$CrCl_3 . 6H_2O$** 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. $Hg[Co(SCN)_4]$

d) $[NiCl_4]^{2-}$ paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic. Explain.
(Atomic no. of Ni = 28)

e) Arrange the following complexes in the decreasing order of conductivity of their solution: $[Co(NH_3)_3Cl_3]$, $[Co(NH_3)_4Cl_2]Cl$, $[Co(NH_3)_6]Cl_3$, $[Cr(NH_3)_5Cl]Cl_2$.

f) Which geometrical isomer of $[CoCl_2(en)_2]^+$ 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 ($C_4H_{10}O$) on oxidation with acidified $K_2Cr_2O_7$ gives carboxylic acid 'B'($C_4H_8O_2$). 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' ($C_4H_{10}O$) 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 of reactions involved.

5

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.

$C_2H_5OH \xrightarrow{\ conc.H_2SO_4/413K\ }$

******