Sample Question Paper-1

(Issued by CBSE on 31st March 2023)

Chemistry (043)

Class- XII, Session: 2023-24

SOLVED

Time Allowed: 3 hours **Maximum Marks: 70**

General Instructions:

Read the following instructions carefully.

(i) There are 33 questions in this question paper with internal choice.
(ii) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
(iii) SECTION B consists of 5 short answer questions carrying 2 marks each.
(iv) SECTION C consists of 7 short answer questions carrying 3 marks each.
(v) SECTION D consists of 2 case - based questions carrying 4 marks each.
(vi) SECTION E consists of 3 long answer questions carrying 5 marks each.
(vii) All questions are compulsory.
(viii) Use of log tables and calculators is not allowed.

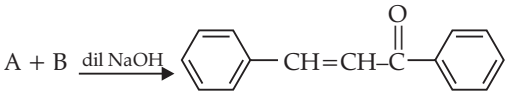
Section-A

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 of the following solutions will have the highest conductivity at 298 K?

(A) 0.01 M HCl solution **(B)** 0.1 M HCl solution
(C) 0.01 M CH_3COOH solution **(D)** 0.1 M CH_3COOH solution **1**

2. Identify A and B:



(A) A = 1-phenylethanal, B = acetophenone **(B)** A = Benzophenone, B = formaldehyde
(C) A = Benzaldehyde, B = Acetophenone **(D)** A = Benzophenone, B = Acetophenone **1**

3. The vitamins which can be stored in our body are:

(A) Vitamin A, B, D and E **(B)** Vitamin A, C, D and K
(C) Vitamin A, B, C and D **(D)** Vitamin A, D, E and K **1**

4. What is IUPAC name of the ketone A, which undergoes iodo form reaction to give $CH_3CH = C(CH_3)COONa$ and yellow precipitate of CHI_3?

(A) 3-Methylpent-3-en-2one **(B)** 3-Methylbut-2-en-one
(C) 2, 3-Dimethylethanone **(D)** 3-Methylpent-4-one **1**

5. Which of the following is not correct?

(A) In haloarenes, the electron pairs on halogen atom are in conjugation with π-electrons of the ring.
(B) The carbon-magnesium bond is covalent and non-polar in nature.
(C) During S_N1 reaction, the carbocation formed in the slow step being sp^2 hybridised is planar.
(D) Out of CH_2= CH – Cl and $C_6H_5CH_2Cl$, $C_6H_5CH_2Cl$ is more reactive towards S_{N1} reaction. **1**

6. Match the properties with the elements of 3d series:

(i) lowest enthalpy of atomisation	(p) Sc
(ii) shows maximum number of oxidation states	(q) Mn
(iii) transition metal that does not form coloured compounds	(r) Zn
	(s) Ti

(A) (i) (r), (ii) (q), (iii) (p) **(B)** (i) (r), (ii) (s), (iii) (p)
(C) (i) (p), (ii) (q), (iii) (r) **(D)** (i) (s), (ii) (r), (iii) (p) **1**

7. Which of the following statement is true?
(A) molecularity of reaction can be zero or a fraction.
(B) molecularity has no meaning for complex reactions.
(C) molecularity of a reaction is an experimental quantity.
(D) reactions with the molecularity three are very rare but are fast. **1**

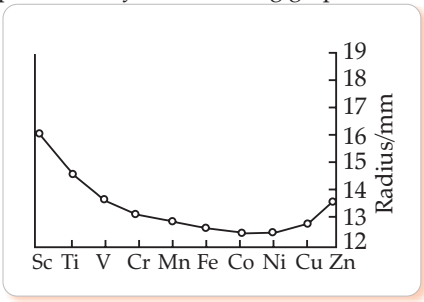
8. In which of the following solvents, the $C_4H_8NH_3^+X^-$ is soluble;
(A) ether **(B)** acetone
(C) water **(D)** bromine water **1**

9. Which of the following observation is shown by 2-phenyl ethanol with Lucas Reagent?
(A) Turbidity will be observed within five minutes
(B) No turbidity will be observed
(C) Turbidity will be observed immediately
(D) Turbidity will be observed at room temperature but will disappear after five minutes. **1**

10. If the initial concentration of substance A is 1.5 M and after 120 seconds the concentration of substance A is 0.75 M, the rate constant for the reaction if it follows zero – order kinetics is:
(A) 0.00625 $molL^{-1}s^{-1}$ **(B)** 0.00625 s^{-1}
(C) 0.00578 $molL^{-1}s^{-1}$ **(D)** 0.00578 s^{-1} **1**

11. Anisole undergoes bromination with bromine in ethanoic acid even in the absence of iron (III) bromide catalyst
(A) Due to the activation of benzene ring by the methoxy group.
(B) Due to the de-activation of benzene ring by the methoxy group.
(C) Due to the increase in electron density at ortho and para positions.
(D) Due to the formation of stable carbocation. **1**

12. The trend of which property is represented by the following graph?



(A) ionization enthalpy **(B)** atomic radii
(C) enthalpy of atomization **(D)** melting point **1**

For Visually Challenged Learners

12. Which of the following is not considered a transition element?
(A) Scandium **(B)** Silver
(C) Vanadium **(D)** Zinc **1**

13. Given below are two statements labelled as Assertion (A) and Reason (R)
Assertion (A): Alcohols react both as nucleophiles and electrophiles.
Reason (R): The bond between C–O is broken when alcohols react as nucleophiles.
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. **1**

14. **Assertion (A):** Strong oxidising agents oxidise toluene and its derivatives to benzoic acids.
Reason (R): It is possible to stop the oxidation of toluene at the aldehyde stage with suitable reagents. **1**

15. **Assertion:** Enzymes are very specific for a particular reaction and for a particular substrate.
Reason: Enzymes are biocatalysts. **1**

16. **Assertion (A):** During electrolysis of aqueous copper sulphate solution using copper electrodes hydrogen gas is released at the cathode.
Reason (R): The electrode potential of Cu^{2+}/Cu is greater than that of H^+/H_2 **1**

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. **(a)** Radioactive decay follows first-order kinetics. The initial amount of two radioactive elements X and Y is 1 g each. What will be the ratio of X and Y after two days if their half- lives are 12 hours and 16 hours respectively?
(b) The hypothetical reaction P + Q → R is half order w.r.t 'P' and zero order w.r.t 'Q'. What is the unit of rate constant for this reaction? **2**

18. A 5% solution of $Na_2SO_4.10H_2O$ (MW = 322) is isotonic with 2% solution of non-electrolytic, non volatile substance X. Find out the molecular weight of X. **2**

19. **(a)** Arrange the isomeric dichlorobenzene in the increasing order of their boiling point and melting points.
(b) Explain why the electrophilic substitution reactions in haloarenes occur slowly and require more drastic conditions as compared to those in benzene. **2**

20. **(a)** Out of p-tolualdehyde and p-nitrobenzaldehyde ,which one is more reactive towards nucleophilic addition reactions, why?
(b) Write the structure of the product formed when acetone reacts with 2, 4 DNP reagent. **2**

OR

Convert the following:
(a) Benzene to m-nitrobenzaldehyde
(b) Bromobenzene to benzoic acid

21. **(a)** DNA fingerprinting is used to determine paternity of an individual. Which property of DNA helps in the procedure?
(b) What structural change will occur when a native protein is subjected to change in pH? **2**

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)** Write the formula for the following coordination compound Bis(ethane-1,2-diamine) dihydroxidochromium(III) chloride
(b) Does ionization isomer for the following compound exist? Justify your answer. $Hg[Co(SCN)_4]$
(c) Is the central metal atom in coordination complexes a Lewis acid or a Lewis base? Explain. **3**

23. **(a)** Can we construct an electrochemical cell with two half-cells composed of $ZnSO_4$ solution and zinc electrodes? Explain your answer.
(b) Calculate the λ^0_m for Cl^- ion from the data given below:
$\Lambda^0_m\ MgCl_2 = 258.6\ Scm^2mol^{-1}$ and $\lambda^0_m\ Mg^{2+} = 106\ Scm^2mol^{-1}$
(c) The cell constant of a conductivity cell is $0.146\ cm^{-1}$. What is the conductivity of 0.01 M solution of an electrolyte at 298 K, if the resistance of the cell is 1000 ohm? **3**

24. Write the name of the reaction, structure and IUPAC name of the product formed when:
(a) phenol reacts with $CHCl_3$ in the presence of NaOH followed by hydrolysis.
(b) $CH_3CH_2CH(CH_3)CH(CH_3)ONa$ reacts with C_2H_5Br
(c) CH_3CH_2CN reacts with stannous chloride in the presence of hydrochloric acid followed by hydrolysis. **3**

25. You are given four organic compounds "A", "B" , "C" and "D". The compounds "A", "B" and "C" form an orange-red precipitate with 2,4 DNP reagent. Compounds "A" and "B" reduce Tollen's reagent while compounds "C" and "D" do not. Both "B" and "C" give a yellow precipitate when heated with iodine in the presence of NaOH. Compound "D" gives brisk effervescence with sodium bicarbonate solution. Identify "A", "B", "C" and "D" given the number of carbon atoms in three of these carbon compounds is three while one has two carbon atoms. Give an explanation for your answer. **3**

26. When sucrose is hydrolysed the optical rotation values are measured using a polarimeter and are given in the following table:

S.No.	Time (hours)	Specific Rotation
(i)	0	+66.5°
(ii)	∞	–39.9°

(a) Account for the two specific rotation values.
(b) What is the specific name given to sucrose based on the above observation.
(c) One of the products formed during the hydrolysis of sucrose is a glucose, that reacts with hydroxylamine to give compound A. Identify compound A. **3**

27. An organic compound A with the molecular formula (+)C_4H_9Br undergoes hydrolysis to form (±) C_4H_9OH. Give the structure of A and write the mechanism of the reaction. **3**

28. The rate constants of a reaction at 200K and 500K are $0.02s^{-1}$ and $0.20s^{-1}$ respectively. Calculate the value of Ea (Given $2.303R = 19.15\ JK^{-1}mol^{-1}$) **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.

Crystal field splitting by various ligands

Metal complexes show different colours due to d-d transitions. The complex absorbs light of specific wavelength to promote the electron from t_{2g} to e_g level. The colour of the complex is due to the transmitted light, which is complementary of the colour absorbed.

The wave number of light absorbed by different complexes of Cr ion are given below:

Complex	Wavenumber of light absorbed (cm^{-1})	Energy of light absorbed (kJ/mol)
$[CrA_6]^{3-}$	13640	163
$[CrB_6]^{3+}$	17830	213
$[CrC_6]^{3+}$	21680	259
$[CrD_6]^{3-}$	26280	314

Answer the following questions:

(a) Out of the ligands "A", "B", "C" and "D", which ligand causes maximum crystal field splitting? Why? **4**

OR

Which of the two, "A" or "D" will be a weak field ligand? Why?

(b) Which of the complexes will be violet in colour? $[CrA_6]^{3-}$ or $[CrB_6]^{3+}$ and why?
(Given: If 560 – 570 nm of light is absorbed, the colour of the complex observed is violet.)

(c) If the ligands attached to Cr^{3+} ion in the complexes given in the table above are water, cyanide ion, chloride ion, and ammonia (not in this order)

Identify the ligand, write the formula and IUPAC name of the following:

(i) $[CrA_6]^{3-}$ (ii) $[CrC_6]^{3+}$

30. The lead-acid battery represents the oldest rechargeable battery technology. Lead acid batteries can be found in a wide variety of applications including small-scale power storage such as UPS systems, ignition power sources for automobiles, along with large, grid-scale power systems. The spongy lead act as the anode and lead dioxide as the cathode. Aqueous sulphuric acid is used as an electrolyte. The half-reactions during discharging of lead storage cells are:

Anode: $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$

Cathode: $PbO_2(S) + 4H^+(aq) + SO_4^{2-}(aq) + 2e^- \rightarrow PbSO_4(S) + 2H_2O$

There is no safe way of disposal and these batteries end - up in landfills. Lead and sulphuric acid are extremely hazardous and pollute soil, water as well as air. Irrespective of the environmental challenges it poses, lead-acid batteries have remained an important source of energy.

Designing green and sustainable battery systems as alternatives to conventional means remains relevant. Fuel cells are seen as the future source of energy. Hydrogen is considered a green fuel. Problem with fuel cells at present is the storage of hydrogen. Currently, ammonia and methanol are being used as a source of hydrogen for fuel cell. These are obtained industrially, so add to the environmental issues.

If the problem of storage of hydrogen is overcome, is it still a "green fuel?" Despite being the most abundant element in the Universe, hydrogen does not exist on its own so needs to be extracted from the water using

electrolysis or separated from carbon fossil fuels. Both of these processes require a significant amount of energy which is currently more than that gained from the hydrogen itself. In addition, this extraction typically requires the use of fossil fuels. More research is being conducted in this field to solve these problems. Despite the problem of no good means to extract Hydrogen, it is a uniquely abundant and renewable source of energy, perfect for our future zero-carbon needs.

Answer the following questions:

(a) How many coulombs have been transferred from anode to cathode in order to consume one mole of sulphuric acid during the discharging of lead storage cell?

(b) How much work can be extracted by using lead storage cell if each cell delivers about 2.0 V of voltage? (1 F = 96500 C)

(c) Do you agree with the statement – "Hydrogen is a green fuel." Give your comments for and against this statement and justify your views. **4**

OR

Imagine you are a member of an agency funding scientific research. Which of the following projects will you fund and why?

(i) safe recycling of lead batteries

(ii) extraction of hydrogen

Section-E

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

31. Attempt any five of the following:

(a) Which of the following ions will have a magnetic moment value of 1.73 BM.
Sc^{3+}, Ti^{3+}, Ti^{2+}, Cu^{2+}, Zn^{2+}

(b) In order to protect iron from corrosion, which one will you prefer as a sacrificial electrode, Ni or Zn? Why? (Given standard electrode potentials of Ni, Fe and Zn are –0.25 V, –0.44 V and –0.76 V respectively.)

(c) The second ionization enthalpies of chromium and manganese are 1592 and 1509 kJ/mol respectively. Explain the lower value of Mn.

(d) Give two similarities in the properties of Sc and Zn.

(e) What is actinoid contraction? What causes actinoid contraction?

(f) What is the oxidation state of chromium in chromate ion and dichromate ion?

(g) Write the ionic equation for reaction of KI with acidified $KMnO_4$. **5**

32. **(a)** What is the effect of temperature on the solubility of glucose in water?

(b) Ibrahim collected a 10mL each of fresh water and ocean water. He observed that one sample labeled "P" froze at 0°C while the other "Q" at -1.3°C. Ibrahim forgot which of the two, "P" or "Q" was ocean water. Help him identify which container contains ocean water, giving rationalization for your answer.

(c) Calculate Van't Hoff factor for an aqueous solution of $K_3[Fe(CN)_6]$ if the degree of dissociation (α) is 0.852. What will be boiling point of this solution if its concentration is 1 molal? (Kb = 0.52 K kg/mol) **5**

OR

(a) What type of deviation from Roult's Law is expected when phenol and aniline are mixed with each other? What change in the net volume of the mixture is expected? Graphically represent the deviation.

(b) The vapour pressure of pure water at a certain temperature is 23.80 mm Hg. If 1 mole of a non-volatile non-electrolytic solute is dissolved in 100g water, Calculate the resultant vapour pressure of the solution.

33. An organic compound with molecular formula $C_7H_7NO_2$ exists in three isomeric forms, the isomer 'A' has the highest melting point of the three. 'A' on reduction gives compound 'B' with molecular formula C_7H_9N. 'B' on treatment with $NaNO_2$/HCl at 0-5°C to form compound 'C'. On treating C with H_3PO_2, it gets converted to D with formula C_7H_8, which on further reaction with CrO_2Cl_2 followed by hydrolysis forms 'E' C_7H_6O. Write the structure of compounds A to E. Write the chemical equations involved. **5**

OR

(a) Account for the following:

(i) N-ethylbenzenesulphonyl amide is soluble in alkali.

(ii) Reduction of nitrobenzene using Fe and HCl is preferred over Sn and HCl.

(b) Arrange the following in:

(i) decreasing order of pKb values $C_6H_5NH_2$, $C_6H_5NHCH_3$, $C_6H_5CH_2NH_2$, CH_3NH_2, NH_3

(ii) increasing order of solubility in water C_2H_5Cl, $C_2H_5NH_2$, C_2H_5OH

(iii) decreasing boiling point CH_3COOH, C_2H_5OH, CH_3NH_2, CH_3OCH_3

SOLUTIONS
Sample Question Paper-1

Marking Scheme- 2023-24 (Issued by Board)
Chemistry

Section-A

1. **Option (B) is correct.**

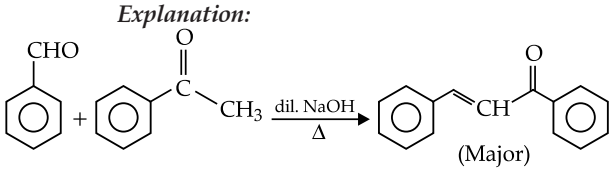
0.1 M HCl solution, conductivity is higher for strong electrolyte, conductivity decreases with dilution.

Explanation: Strong electrolytes (HCl) have higher conductivity than weak electrolytes (CH_3COOH), i.e., the HCl molecules are more likely to ionise (break down into ions) in water, which increases the electrical conductivity of the solution. During dilution, the number of ions present per unit volume carrying the current tends to decrease, which results in a decrease in the conductivity of the electrolytic solution. Thus, 0.1 M HCl solution has more ions than a solution of 0.001 M HCl.

2. **Option (C) is correct.**

A= Benzaldehyde, B= Acetophenone. This is an example of crossed Aldol condensation.

Explanation:



(Major)
Cross.Aldol product

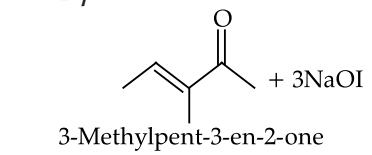
3. **Option (D) is correct.**

Vitamin A,D, E and K. These are fat soluble vitamins. Fat soluble vitamins can be stored in our body.

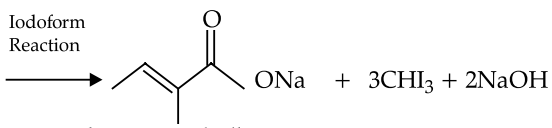
4. **Option (A) is correct.**

3-Methylpent-3-en-2-one

Explanation:



3-Methylpent-3-en-2-one



sodium 2-methylbut-2-enoate

5. **Option (B) is correct.**

The carbon-magnesium bond is covalent and non-polar in nature.

Explanation: The bond between carbon and magnesium is ionic in nature, (grignard reagent R-Mg-X. This is highly polar in nature due to difference in electronegativity between carbon and magnesium.

6. **Option (A) is correct.**

Explanation: Zinc has no unpaired electrons in 3d or 4s orbitals, so enthalpy of atomisation is low.

Mn = $3d^5 4s^2$ shows +2, +3, +4, +5, +6 and +7 oxidation state, maximum number in 3*d* series. Scandium (Sc) do not form coloured compound because in d-orbital only one electron is available. Hence, *d-d* transition do not take place.

7. **Option (B) is correct.**

Molecularity has no meaning for complex reactions.

Explanation: Only for elementary reactions molecularity is applicable as they are the single step reactions and the rate depends on the concentration of each molecule, whereas in case of complex reactions there are multiple reactions involved and hence molecularity holds no meaning.

8. **Option (C) is correct.**

Water

Explanation: The relatively high solubility is attributed to the hydrogen bonding that takes place between the ammonia and water molecules. The dissolving of ammonium ions in water forms a basic solution.

9. **Option (B) is correct.**

Explanation: no turbidity will be observed, given compound is a primary alcohol.

10. **Option (A) is correct.**

Explanation: 0.00625 $molL^{-1}s^{-1}$, for zero order $K = \frac{[R_0]-[R]}{t} = 1.5 - 0.75 / 120 = 0.00625$ $molL^{-1}s^{-1}$

11. **Option (A) is correct.**

Due to the activation of benzene ring by the methoxy group.

Explanation: In electrophilic aromatic substitution reaction, anisole undergo bromination with bromine in ethanoic acid (acetic acid) to form mixture of o- and p- bromo anisole. H atom attached to benzene ring is replaced with bromine atom as methoxy group is o, p-directing group.

12. **Option (B) is correct.**

atomic radii

Explanation: Atomic radius in a transition series does not vary much due to more pronounced shielding effect of penultimate d-subshell in transition elements. Thus, atomic radii of the first transition series decrease from Sc to Cr, then remains almost constant till Ni and then increases from Cu to Zn.

for visually challenged learners

12. **Option (D) is correct.**

Zinc

Explanation: Transition elements are characterized by partially filled (n-1) d subshells. Zinc is not a transition element as it has completely filled 3d subshell.

13. **Option (C) is correct.**

A is true but R is false

Explanation: Alcohols react both as nucleophiles and electrophiles. The bond between O – H is broken when an alcohol reacts as a nucleophile whereas the bond between C – O is broken when alcohols react as electrophiles.

14. **Option (B) is correct.**

Both A and R are true but R is not the correct explanation of A

Explanation: Toluene is oxidised with alkaline $KMnO_4$ followed by acidification to form benzoic acid. The oxidation can be stopped at the aldehyde stage by using those suitable reagents to convert the methyl group to an intermediate that cannot be oxidised further such as using CrO_2Cl_2, CrO_3 or treating by Gatterman -Koch reaction.

15. **Option (B) is correct.**

Both A and R are true and R is not the correct explanation of A.

Explanation: Enzymes are substrate selective and reaction specific; i.e., enzymes are highly specific in their action. Each enzyme catalyzes only one type of reaction in only one compound or a group of structurally related compounds.

16. **Option (D) is correct.**

A is false but R is true. Cu will deposit at cathode

Explanation: Cu will deposit at cathode because copper is below hydrogen in the electrochemical series.

Section-B

17. (a) For first order reaction
half life of X = 12 hours
2 days = 48 hours means 4 half lives , amount of X left = 1/16 of initial value half life of Y = 16 hours **(½)**
2 days = 48 hours means 3 half lives, amount left = 1/8 of initial value Ratio of X : Y = 1 : 2 **(½)**

(b) $\mathbf{mol^{1/2}L^{-1/2}s^{-1}}$ as Rate = $k[P]^{1/2}$ **(1)**

Explanation:
Rate= $k[P]^{1/2}[Q]^0$
$[molL^{-1}s^{-1}] = k[molL^{-1}]$
Unit of k= $mol^{1/2}L^{-1/2}s^{-1}$

18.

$$\pi_1 = \pi_2 \quad (½)$$

$$iC_1RT = C_2RT \quad (½)$$

$$\frac{3\times5}{322} = \frac{2}{M}$$

$$M = \frac{2\times322}{3\times5}$$

$$M = 42.9\ g$$

19. **(a)** m-dicholrobenzene < o-dicholrobenze < p-dicholrobenze **(½)**

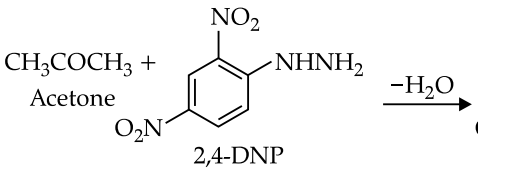
Symmetrical structure and close packing in para isomer

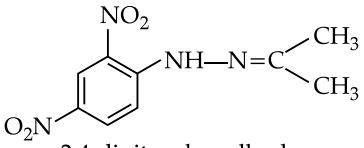
ortho has a stronger dipole dipole interaction as compared to meta, **(½)**

(b) The halogen atom because of its –I effect has some tendency to withdraw electrons from the benzene ring. As a result, the ring gets somewhat deactivated as compared to benzene and hence the electrophilic substitution reactions in haloarenes occur slowly and require more drastic conditions as compared to those in benzene. **(1)**

20. **(a)** p-nitrobenzaldehyde is more reactive towards the nucleophilic addition reaction than p-tolualdehyde as Nitro group is electron withdrawing in nature . Presence of nitro group decrease electron density, hence facilitates the attack of nucleophile . Presence of $–CH_3$ leads to +I effect as $–CH_3$ is electron releasing group. **(1)**

(b)

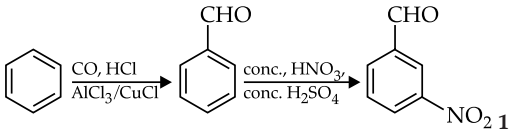




2,4-dinitrophenylhydrozone
(yellow precipitate)

OR

(a)



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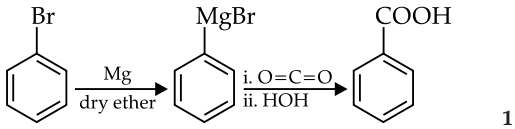
(b)



1

21. **(a)** Replication

A sequence of bases on DNA is unique for a person and is the genetic material transferred to the individual from the parent which helps in the determination of paternity. **(1)**

(b) During denaturation secondary and tertiary structures are destroyed but the primary structure remains intact. **(1)**

Section-C

22. **(a)** $[Cr(en)_2(OH)_2]Cl$
or $[Cr(H_2NCH_2CH_2NH_2)_2(OH)_2]Cl$ **(1)**

(b) No, ionization isomers are possible by exchange of ligand with counter ion only and not by exchange of central metal ion. **(1)**

(c) The central atom is electron pair acceptor so it is a Lewis acid. **(1)**

23. **(a)** Yes, if the concentration of $ZnSO_4$ in the two half cell is different, the electrode potential will be different making the cell possible. **(1)**

(b) $\Lambda^0_m(MgCl_2) = \lambda^0_m(Mg^{2+}) + 2\lambda^0_m(Cl^-)$

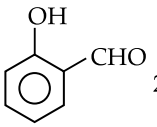
$258.6 = 106 + 2\lambda^0_m(Cl^-)$

$\lambda^0_m(Cl^-) = 76.3\ Scm^2mol^{-1}$ **(1)**

(c) cell constant $G^* = k \times R$

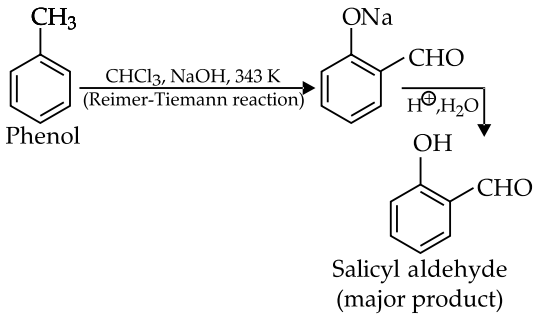
$$k = \frac{G^*}{R} = \frac{0.146}{1000} = 1.46 \times 10^{-4}\ Scm^{-1}. \quad (1)$$

24. **(a)** Reimer Tiemann,



2-Hydroxybenzaldehyde

(½+½)



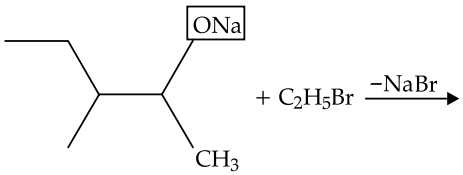
Salicyl aldehyde
(major product)

(b) Williamson synthesis, $CH_3CH_2CH(CH_3)CH(CH_3)OC_2H_5$

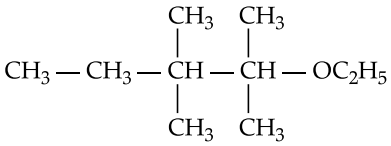
2-Ethoxy-3-methylpentane

(½+½+½)

Explanation:



Sodium-3-methyl-2-pentoxide



(c) Stephen reaction, CH_3CH_2CHO, Propanal

$$CH_3CH_2CN + [H] + HCl \xrightarrow[H_2O]{\text{Boiling}}$$

$$CH_3CH_2CHO + NH_4Cl$$

(Propanal)

(½+½+½)

25. A, B and C contain carbonyl group as they give positive 2,4 DNP test

A and B are aldehydes as aldehydes reduce Tollen's reagent

C is a ketone, as it contains carbonyl group but does not give positive Tollen's test **(½)**

C is a methyl ketone as it gives positive iodoform test

B is an aldehyde that gives positive iodoform test **(½)**

D is a carboxylic acid

Since the number of carbons in the compounds A,B,C and D is three or two

B is CH_3CHO as this is only aldehyde which gives a positive iodoform test **(½)**

The remaining compounds A, C and D have three carbons

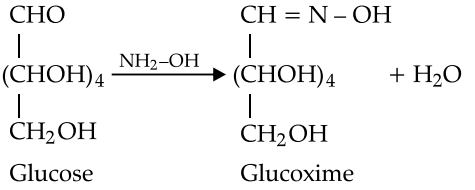
A is CH_3CH_2CHO, C is CH_3COCH_3 and D is CH_3CH_2COOH **(½ each)**

26. **(a)** The reactant Sucrose is dextrorotatory. On hydrolysis it give glucose dextrorotatory and fructose which is laevorotatory. The specific rotation of fructose is higher than glucose

Sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose. Since the laevorotation of fructose (–92.4°) is more than dextrorotation of glucose (+52.5°), the mixture is laevorotatory. **(1)**

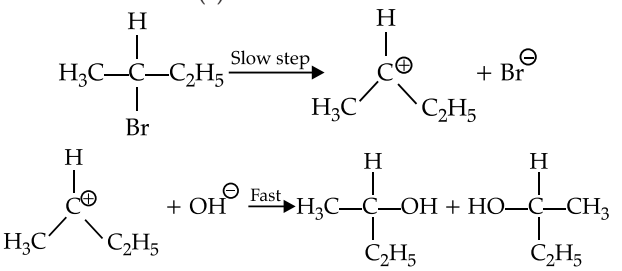
(b) Invert sugar. The hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (–) and the product is named as invert sugar. **(1)**

(c) Glucoxime



27. $C_2H_5 - CH(Br) - CH_3$

Mechanism : (1)



28.

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\log\frac{0.20}{0.02} = \frac{E_a}{2.303R}\left[\frac{1}{200} - \frac{1}{500}\right]$$

$$\log 10 = \frac{E_a}{19.15}\left(\frac{300}{200\times 500}\right)$$

$$E_a = \frac{19.15\times 200\times 500}{300}$$

$$E_a = 6383.33\ \text{J/mol}$$ **(1+1+1)**

Section-D

29. **(a)** D ligand cause maximum field splitting. Energy is directly proportional to the wave number. Maximum energy of light is required for an electron to jump from t_{2g} to e_g in case of $[CrD_6]^{3-}$ **(½+½)**

OR

A will be a weak field ligand. The splitting caused in least in this case as the energy required for electron to jump from t_{2g} to e_g., is minimum. **(½+½)**

(b) $[CrB_6]^{3+}$ will be violet in colour. Wavelength of light absorbed is $\frac{1}{17830}$ = 560nm for the complex while $\frac{1}{13640}$ = 733 nm for $[CrA_6]^{3-}$ complex. **(½+½)**

(c) (i) $[CrCl_6]^{3-}$, Hexachloridochromate(III) ion **(1 each)**

(ii) $[Cr(NH_3)_6]^{3+}$, Hexaamminechromium(III) ion
A = Cl^-, B = H_2O, C = NH_3, D = CN^-

30. **(a)** 2mol e^- (or 2F) have been transferred from anode to cathode to consume 2 mol of H_2SO_4 therefore, one mole H_2SO_4 requires one faraday of electricity or 96500 coulombs.

(b) $w_{max} = -nFE^\circ = -2 \times 96500 \times 2.0 = 386000$ J of work can be extracted using lead storage cell when the cell is in use.

(c) Both yes and no should be accepted as correct answers depending upon what explanation is provided.

Yes, Hydrogen is a fuel that on combustion gives water as a by product. There are no carbon emissions and no pollutions caused.

However, at present the means to obtain hydrogen are electrolysis of water which use electricity obtained from fossil fuels and increase carbon emissions.

Inspite of the problems faced today in the extraction of hydrogen, we cannot disagree on the fact that hydrogen is a clean source of energy. Further research can help in finding solutions and greens ways like using solar energy for extraction of hydrogen. **(2)**

No. It is true that Hydrogen is a fuel that on combustion gives water as a byproduct. There are no carbon emissions and no pollutions caused.

However, at present the means to obtain hydrogen are electrolysis of water which use electricity obtained from fossil fuels and increase carbon emissions.

Hydrogen is no doubt a green fuel, but the process of extraction is not green as of today. At present, looking at the process of extraction, hydrogen is not a green fuel. **(2)**

OR

Both answers will be treated as correct

(i) Lead batteries are currently the most important and widely used batteries. These are rechargeable. The problem is waste management which needs research and awareness. Currently, these are being thrown into landfills and there is no safe method of disposal or recycling. Research into safer method of disposal will reduce the pollution and health hazards caused to a great extent.

(1 mark for importance, 1 for need for the research)

(ii) Fuel cell is a clean source of energy. Hydrogen undergoes combustion to produce water. The need of the hour is green fuel and hydrogen is a clean fuel. The current problem is obtaining hydrogen. Research that goes into this area will help solve the problem of pollution and will be a sustainable solution.

(1 mark for importance, 1 for need for the research)

Section-E

31. **(a)** Both Ti^{3+} and Cu^{2+} have 1 unpaired electron, so the magnetic moment for both will be 1.73 BM

(b) Zn, it has a more negative electrode potential so will corrode itself in place of iron.

(c) Mn^+ has $3d^5 4s^1$ configuration and configuration of Cr^+ is $3d^5$, therefore, ionisation enthalpy of Mn^+ is lower than Cr^+.

(d) Sc and Zn both form colourless compound and are diamagnetic.

(e) The decrease in the atomic and ionic radii with increase in atomic number of actinoids due to poor shielding effect of 5f electron.

(f) In both chromate and dichromate ion the oxidation state of Cr is +6

(g) $10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5I_2$

(1 each, any 5)

32. **(a)** Addition of glucose to water is an endothermic reaction. According to Le Chatelier's principle, on increase in temperature, solubility will increase.

(b) Q is ocean water, due to the presence of salts it freezes at lower temperature (depression in freezing point)

(c) $K_3[Fe(CN)_6]$ gives 4 ions in aqueous solution **(½)**

$i = 1 + (n - 1)\alpha$

$i = 1 + (4 - 1) \times 0.852$

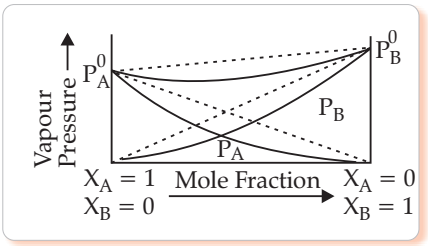
$i = 3.556$ **(½)**

$\Delta T_b = iK_b m = 3.556 \times 0.52 \times 1 = 1.849$ **(1)**

$T_b = 273.15 + 1.849 = 274.99$ K **(½)**

OR

(a) Negative Deviation is expected when phenol and aniline are mixed with each other. The net volume of the mixture will decrease, $\Delta V < 0$ due to stronger intermolecular interactions. **(1)**



(b) Relative lowering of vapour pressure $= \frac{(P^\circ - P)}{P^\circ}$

$= x_2 = \frac{n_2}{n_1}$

$n_2 = 0.1$

$n_1 = 100/18$

$x_2 = \frac{0.1}{5.55 + 0.1} = \frac{0.1}{5.65} = 0.018$ **(½)**

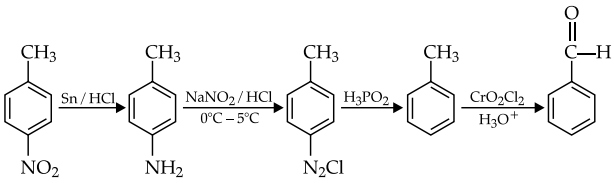
$P^\circ = 23.8$ mm Hg

Relative lowering of vapour pressure $= \frac{(23.80 - P)}{23.80} = 0.018$ **(½)**

$23.80 - P = 0.428$ **(½)**

$P = 23.80 - 0.428 = 23.37$ mm Hg (1)

33. Compound "A" is p-methylnitrobenzene
Compound 'B" is p- methylbenzenamine Compound C is p-methylbenzenediazoiumchloride Compound D – Toluene Compound E - Benzaldehyde
The chemical reactions involved are



(1 mark for correct identification of A, 1 each for identification and reaction of formation of B, C, D and E from A)

OR

(a) **(i)** The hydrogen attached to N-Ethylbenzene sulphonamide is acidic in nature. This is due to the presence of strong electron withdrawing sulphonyl group. Hence, it is soluble in alkali. **(1)**

(ii) Reduction with iron scrap and hydrochloric acid is preferred because $FeCl_2$ formed gets hydrolysed to release hydrochloric acid during the reaction. Thus, only a small amount of hydrochloric acid is required to initiate the reaction. **(1)**

(b) **(i)** $C_6H_5NH_2 > C_6H_5NHCH_3 > NH_3 > C_6H_5CH_2NH_2 > CH_3NH_2$ **(1)**

(ii) $C_2H_5Cl < C_2H_5NH_2 < C_2H_5OH$ **(1)**

(iii) $CH_3COOH > C_2H_5OH > CH_3NH_2 > CH_3OCH_3$ **(1)**

■■