Sample Question Paper-1

(Issued by Board dated 16th Sep., 2022)

Chemistry

Class-XII

SOLVED

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

General Instructions:

Read the following instructions carefully.

(i) *There are* **35** *questions in this question paper with internal choice.*

(ii) *SECTION A consists of 18 multiple-choice questions carrying 1 mark each.*

(iii) *SECTION B consists of 7 very short answer questions carrying 2 marks each.*

(iv) *SECTION C consists of 5 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. The major product of acid catalysed dehydration of 1-methylcyclohexanol is:

(A) 1-methylcyclohexane **(B)** 1-methylcyclohexene

(C) 1-cyclohexylmethanol **(D)** 1-methylenecyclohexane

2. Which one of the following compounds is more reactive towards S_N1 reaction?

(A) $CH_2 = CHCH_2Br$ **(B)** $C_6H_5CH_2Br$

(C) $C_6H_5CH\ (C_6H_5)Br$ **(D)** $C_6H_5CH(CH_3)\ Br$

3. $KMnO_4$ is coloured due to:

(A) *d-d* transitions **(B)** charge transfer from ligand to metal

(C) unpaired electrons in *d* orbital of Mn **(D)** charge transfer from metal to ligand

4. Which radioactive isotope would have the longer half- life ^{15}O or ^{19}O? (Given rate constants for ^{15}O and ^{19}O are $5.63 \times 10^{-3}\ s^{-1}$ and $k = 2.38 \times 10^{-2} s^{-1}$ respectively.)

(A) ^{15}O **(B)** ^{19}O

(C) Both will have the same half-life **(D)** None of the above, information given is insufficient

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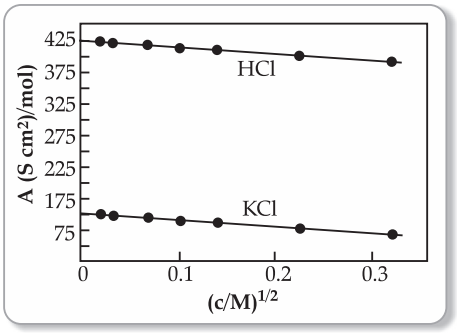
5. The molar conductivity of CH_3COOH at infinite dilution is 390 S cm^2/mol. Using the graph and given information, the molar conductivity of CH_3COOK will be:



(A) 100 S cm^2/mol **(B)** 115 S cm^2/mol

(C) 150 S cm^2/mol **(D)** 125 S cm^2/mol

***FOR VISUALLY CHALLENGED LEARNERS**

***5.** What is the molar conductance at infinite dilution for sodium chloride if the molar conductance at infinite dilution of Na^+ and Cl^- ions are 51.12×10^{-4} Scm^2/mol and 73.54×10^{-4} Scm^2/mol respectively?

(A) 124.66 S cm^2/mol **(B)** 22.42 S cm^2/mol

(C) 198.20 S cm^2/mol **(D)** 175.78 S cm^2/mol

6. For the reaction, $A + 2B \rightarrow AB_2$, the order w.r.t. reactant A is 2 and w.r.t. reactant B is zero. What will be change in rate of reaction if the concentration of A is doubled and B is halved?

(A) increases four times **(B)** decreases four times

(C) increases two times **(D)** no change

7. Arrange the following in the increasing order of their boiling points:

A: Butanamine, B: N,N-Dimethylethanamine, C: N- Ethylenediamine

(A) C<B<A **(B)** A<B<C

(C) A<C<B **(D)** B<C<A

8. The CFSE of $[CoCl_6]^{3-}$ is 18000 cm^{-1} the CFSE for $[CoCl_4]^-$ will be:

(A) 18000 cm^{-1} **(B)** 8000cm^{-1}

(C) 2000 cm^{-1} **(D)** 16000 cm^{-1}

9. What would be the major product of the following reaction?

$C_6H_5 - CH_2 - OC_6H_5 + HBr \rightarrow A + B$

(A) A= $C_6H_5CH_2OH$, B = C_6H_6 **(B)** A = $C_6H_5CH_2OH$, B = C_6H_5Br

(C) A= $C_6H_5CH_3$, B = C_6H_5Br **(D)** A = $C_6H_5CH_2Br$, B = C_6H_5OH

10. Which of the following statements is not correct for amines?

(A) Most alkyl amines are more basic than ammonia solution.

(B) pK_b value of ethylamine is lower than benzylamine.

(C) CH_3NH_2 on reaction with nitrous acid releases NO_2 gas.

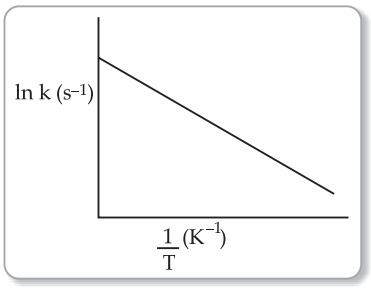
(D) Hinsberg's reagent reacts with secondary amines to form sulphonamides.

11. Which of the following tests/ reactions is given by aldehydes as well as ketones?

(A) Fehling's test **(B)** Tollen's test

(C) 2,4 DNP test **(D)** Cannizzaro reaction

12. Arrhenius equation can be represented graphically as follows:



The (i) intercept and (ii) slope of the graph are:

(A) (i) ln A (ii) E_a/R **(B)** (i) A (ii) E_a

(C) (i)ln A (ii) $-E_a/R$ **(D)** (i) A (ii) $-E_a$

***FOR VISUALLY CHALLENGED LEARNERS**

***12.** The unit of rate constant for the reaction $2A + 2B \rightarrow A_2B_2$ which has rate = $k[A]^2[B]$ is:

(A) mol $L^{-1}s^{-1}$ **(B)** s^{-1}

(C) mol L^{-1} **(D)** $mol^{-2}\ L^2\ s^{-1}$

13. The number of ions formed on dissolving one molecule of $FeSO_4.(NH_4)_2SO_4.6H_2O$ in water is:

(A) 3 **(B)** 4

(C) 5 **(D)** 6

14. The oxidation of toluene to benzaldehyde by chromyl chloride is called

(A) Etard reaction **(B)** Riemer-Tiemann reaction

(C) Stephen's reaction **(D)** Cannizzaro's reaction

Questions 15-18 are Assertion and Reason Questions:

Given below are two statements labelled as Assertion (A) and Reason (R)

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. **Assertion (A):** An ether is more volatile than an alcohol of comparable molecular mass.

Reason (R): Ethers are polar in nature.

16. **Assertion (A):** Proteins are found to have two different types of secondary structures viz alpha-helix and beta-pleated sheet structure.

Reason (R): The secondary structure of proteins is stabilised by hydrogen bonding.

Select the most appropriate answer from the options given below:

17. **Assertion:** Magnetic moment values of actinides are lesser than the theoretically predicted values.

Reason: Actinide elements are strongly paramagnetic.

18. **Assertion (A):** Tertiary amines are more basic than corresponding secondary and primary amines in gaseous state.

Reason (R): Tertiary amines have three alkyl groups which cause +I effect.

Section - B

This section contains 7 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.

19. A first-order reaction takes 69.3 min for 50% completion. What is the time needed for 80% of the reaction to get completed? (Given: log 5 =0.6990, log 8 = 0.9030, log 2 = 0.3010)

20. Account for the following:

(a) There are 5 –OH groups in glucose.

(b) Glucose is a reducing sugar.

OR

What happens when D – glucose is treated with the following reagents:

(a) Bromine water

(b) HNO_3

21. Give reason for the following:

(a) During the electrophilic substitution reaction of haloarenes, *para* substituted derivative is the major product.

(b) The product formed during S_N1 reaction is a racemic mixture.

OR

(a) Name the suitable alcohol and reagent, from which 2-chloro-2-methyl propane can be prepared.

(b) Out of the Chloromethane and Fluoromethane , which one is has higher dipole moment and why?

22. The formula $Co(NH_3)_5CO_3Cl$ could represent a carbonate or a chloride. Write the structures and names of possible isomers.

23. Corrosion is an electrochemical phenomenon. The oxygen in moist air reacts as follows:

$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$.

Write down the possible reactions for corrosion of zinc occurring at anode, cathode, and overall reaction to form a white layer of zinc hydroxide.

24. Explain how and why will the rate of reaction for a given reaction be affected when

(a) a catalyst is added

(b) the temperature at which the reaction was taking place is decreased.

25. Write the reaction and IUPAC name of the product formed when 2-Methylpropanal (isobutyraldehyde) is treated with ethyl magnesium bromide followed by hydrolysis.

Section - C

This section contains 5 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.

26. Write the equations for the following reaction:

(a) Salicylic acid is treated with acetic anhydride in the presence of conc. H_2SO_4.

(b) *Tert*-butyl chloride is treated with sodium ethoxide.

(c) Phenol is treated with chloroform in the presence of NaOH

27. Using Valence bond theory, explain the following in relation to the paramagnetic complex $[Mn(CN)_6]^{3-}$

(a) type of hybridisation

(b) magnetic moment value

(c) type of complex – inner, outer orbital complex

28. Answer the following questions:

(a) State Henry's law and explain why are the tanks used by scuba divers filled with air diluted with helium (11.7% helium, 56.2% nitrogen and 32.1% oxygen)?

(b) Assume that argon exerts a partial pressure of 6 bar. Calculate the solubility of argon gas in water. (Given Henry's law constant for argon dissolved in water, K_H = 4 kbar)

29. Give reasons for any 3 of the following observations:

(a) Aniline is acetylated before nitration reaction.

(b) pK_b of aniline is lower than the *m*-nitroaniline.

(c) Primary amine on treatment with benzenesulphonyl chloride forms a product which is soluble in NaOH however secondary amine gives product which is insoluble in NaOH.

(d) Aniline does not react with methyl chloride in the presence of anhydrous $AlCl_3$ catalyst.

30. **(a)** Identify the major product formed when 2-cyclohexylchloroethane undergoes a dehydrohalogenation reaction. Name the reagent which is used to carry out the reaction.

(b) Why are haloalkanes more reactive towards nucleophilic substitution reactions than haloarenes and vinylic halides?

OR

(a) Name the possible alkenes which will yield 1-chloro-1-methylcyclohexane on their reaction with HCl. Write the reactions involved.

(b) Allyl chloride is hydrolysed more readily than *n*-propyl chloride. Why?

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.

31. **Strengthening the Foundation: Chargaff Formulates His "Rules"**

Many people believe that James Watson and Francis Crick discovered DNA in the 1950s. In reality, this is not the case. Rather, DNA was first identified in the late 1860s by Swiss chemist Friedrich Miescher. Then, in the decades following Miescher's discovery, other scientists--notably, Phoebus Levene and Erwin Chargaff--carried out a series of research efforts that revealed additional details about the DNA molecule, including its primary chemical components and the ways in which they joined with one another. Without the scientific foundation provided by these pioneers, Watson and Crick may never have reached their groundbreaking conclusion of 1953: that the DNA molecule exists in the form of a three-dimensional double helix.

Chargaff, an Austrian biochemist, as his first step in this DNA research, set out to see whether there were any differences in DNA among different species. After developing a new paper chromatography method for separating and identifying small amounts of organic material, Chargaff reached two major conclusions:

(i) the nucleotide composition of DNA varies among species.

(ii) Almost all DNA, no matter what organism or tissue type it comes from maintains certain properties, even as its composition varies. In particular, the amount of adenine (A) is similar to the amount of thymine (T), and the amount of guanine (G) approximates the amount of cytosine (C). In other words, the total amount of purines (A + G) and the total amount of pyrimidines (C + T) are usually nearly equal. This conclusion is now known as "Chargaff's rule."

Chargaff's rule is not obeyed in some viruses. These either have single- stranded DNA or RNA as their genetic material.

Answer the following questions:

(a) A segment of DNA has 100 adenine and 150 cytosine bases. What is the total number of nucleotides present in this segment of DNA?

(b) A sample of hair and blood was found at two sites. Scientists claim that the samples belong to same species. How did the scientists arrive at this conclusion?

(c) The sample of a virus was tested and it was found to contain 20% adenine, 20% thymine, 20 % guanine and the rest cytosine. Is the genetic material of this virus (a) DNA- double helix (b) DNA-single helix (c) RNA? What do you infer from this data?

OR

How can Chargaff's rule be used to infer that the genetic material of an organism is double- helix or single- helix?

32. Henna is investigating the melting point of different salt solutions.

She makes a salt solution using 10 mL of water with a known mass of NaCl salt.

She puts the salt solution into a freezer and leaves it to freeze.

She takes the frozen salt solution out of the freezer and measures the temperature when the frozen salt solution melts.

She repeats each experiment.

S.No.	Mass of the salt used in g	Melting point in ^{0}C	
		Readings Set 1	Readings Set 2
1	0.3	-1.9	-1.9
2	0.4	-2.5	-2.6
3	0.5	-3.0	-5.5
4	0.6	-3.8	-3.8
5	0.8	-5.1	-5.0
6	1.0	-6.4	-6.3

Assuming the melting point of pure water as 0oC, answer the following questions:

(a) One temperature in the second set of results does not fit the pattern. Which temperature is that? Justify your answer.

(b) Why did Henna collect two sets of results?

(c) In place of NaCl, if Henna had used glucose, what would have been the melting point of the solution with 0.6 g glucose in it?

OR

What is the predicted melting point if 1.2 g of salt is added to 10 mL of water? Justify your answer.

Section - E

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

33. **(a)** Why does the cell voltage of a mercury cell remain constant during its lifetime?

(b) Write the reaction occurring at anode and cathode and the products of electrolysis of aq.KCl.

(c) What is the pH of HCl solution when the hydrogen gas electrode shows a potential of -0.59 V at standard temperature and pressure?

OR

(a) Molar conductivity of substance "A" is 5.9×10^3 S/m and "B" is 1×10^{-16} S/m. Which of the two is most likely to be copper metal and why?

(b) What is the quantity of electricity in coulombs required to produce 4.8 g of Mg from molten $MgCl_2$? How much Ca will be produced if the same amount of electricity was passed through molten $CaCl_2$? (Atomic mass of Mg = 24 u, atomic mass of Ca = 40 u).

(c) What is the standard free energy change for the following reaction at room temperature? Is the reaction spontaneous?

$Sn(s) + 2Cu^{2+}(aq) \rightarrow Sn^{2+}(aq) + 2Cu^{+}(s)$

34. A hydrocarbon (A) with molecular formula C_5H_{10} on ozonolysis gives two products (B) and (C). Both (B) and (C) give a yellow precipitate when heated with iodine in presence of NaOH while only (B) give a silver mirror on reaction with Tollen's reagent.

(a) Identify (A), (B) and (C).

(b) Write the reaction of B with Tollen's reagent.

(c) Write the equation for iodoform test for C.

(d) Write down the equation for aldol condensation reaction of B and C.

OR

An organic compound (A) with molecular formula $C_2Cl_3O_2H$ is obtained when (B) reacts with Red P and Cl_2. The organic compound (B) can be obtained on the reaction of methyl magnesium chloride with dry ice followed by acid hydrolysis.

(a) Identify A and B.

(b) Write down the reaction for the formation of A from B. What is this reaction called?

(c) Give any one method by which organic compound B can be prepared from its corresponding acid chloride.

(d) Which will be the more acidic compound (A) or (B)? Why?

(e) Write down the reaction to prepare methane from the compound (B).

35. Answer the following:

(a) Why are all copper halides known except that copper iodide?

(b) Why is the $E^\circ_{(V^{3+}/V^{2+})}$ value for vanadium comparatively low?

(c) Why HCl should not be used for potassium permanganate titrations?

(d) Explain the observation, at the end of each period, there is a slight increase in the atomic radius of *d* block elements.

(e) What is the effect of *pH* on dichromate ion solution?

■■■

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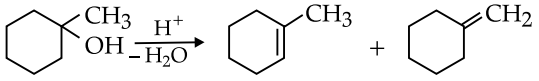
SOLUTIONS
Sample Question Paper-1
With CBSE Marking Scheme 2022-23
Chemistry

Section - A

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

Explanation: According to Saytzeff rule, i.e., highly substituted alkene is major product. Here dehydration reaction takes place, alkene is formed due to the removal of a water molecule.



l-Methylcyclohexanol | l-Methylcyclohexene (Major product) | l-Methylene cyclohexane (Minor product)

2. **Option (C) is correct.** 1

Explanation: C_6H_5CH $(C_6H_5)^+$ carbocation formed is more stable.

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

Explanation: The Mn atom in $KMnO_4$ has +7 oxidation state with electron configuration $[Ar]3d^0 4s^0$. Since no unpaired electrons are present, $d-d$ transitions are not possible. The molecule should, therefore, be colourless.

Its intense purple is due to L→M (ligand to metal) charge transfer $2p$(L) of O to $3d$(M) of Mn.

4. **Option (A) is correct.** 1

Explanation: The rate constant for the decay of O–15 is less than that for O–19 . Therefore , the rate of decay of O–15 will be slower and will have a longer half life.

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

Explanation: $\Lambda^O_{CH_3COOK} = \Lambda^O_{CH_3COOH} + \Lambda^O_{KCl} - \Lambda^O_{HCl} = 390 + 150 - 425 = 115$ S cm^2/mol

5* **(For visually challenged learners)**

Option (A) is correct. 1

Explanation: 124.66×10^{-4} Sm^{2}mol^{-1}

Molar conductance of NaCl $= \lambda^+_{Na^+} + \lambda^+_{Cl^-}$

$= 51.12 \times 10^{-4} + 73.54 \times 10^{-4}$

$= 124.66 \times 10^{-4}$ Sm^{2}mol^{-1}

6. **Option (A) is correct.** 1

Explanation: Rate $= [A]^2 [B]^0$

If [A] is doubled then Rate' $= [2A]^2 = 4 [A]^2 = 4$ Rate

7. **Option (D) is correct.** 1

Explanation: In primary amine, intermolecular association due to H-bonding is maximum while in tertiary it is minimum as there is no covalently bonded hydrogen with N.

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

Explanation: $\Delta_t = (4/9) \times 18000 cm^{-1} = 8000\ cm^{-1}$

9. **Option (D) is correct.** 1

Explanation: Since, carbocation is stabilised by resonance as well as +I effect.

10. **Option (C) is correct.** 1

Explanation: CH_3NH_2 on reaction with nitrous acid releases nitrogen gas.

$$CH_3NH_2 + HNO_2 \rightarrow CH_3OH + N_2\uparrow + H_2O$$

11. **Option (C) is correct.** 1

Explanation: Fehling's, Tollen's and Cannizzao reaction is shown by alcohols only.

12. **Option (C) is correct.** 1

12* **For visually challenged learners.**

Option (D) is correct. 1

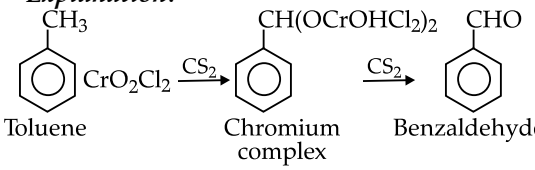
Explanation: Since, The order of reaction is 3, so the unit is mol^{-2} L^2 s^{-1}.

13. **Option (C) is correct.** 1

Explanation: 1Fe^{2+}, 2 SO_4^{2-} and 2 NH_4^+ ions

14. **Option (A) is correct.** 1

Explanation:



Toluene | Chromium complex | Benzaldehyde

This reaction is known as Etard reaction.

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

Explanation: An ether is more volatile than an alcohol of comparable mass because hydrogen bonding does not exist amongst ether molecules.

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

Explanation: Two major factors stabilise the α-helix structure are intramolecular H-bonding and minimisation of steric interference between side chains.

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

Explanation: The magnetic moment is less as the

5 f electrons of actinides are less effectively shielded which results in quenching of orbital contributions, they are strongly paramagnetic due to presence of unpaired electrons.

18. **Option (A) is correct.** **1**

***Explanation*:** Basicity order of amines in gaseous phase vary with +I group. Due to electron releasing nature of alkyl group it pushes electrons towards nitrogen thus, make the unshared pair more available for sharing. The basic nature increases with increase in number of alkyl groups.

Section - B

19. Half life $t_{½} = 0.693/k$

$$k = \frac{0.693}{69.3}$$

$$= \frac{1}{100}$$

$= 0.01\ min^{-1}$ ½

For first order reaction

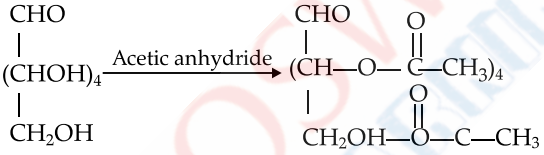
$$k = \frac{2.303}{t}\log\frac{[R_O]}{[R]}$$ **1**

$$t = \frac{2.303}{0.01}\log\frac{100}{20}$$

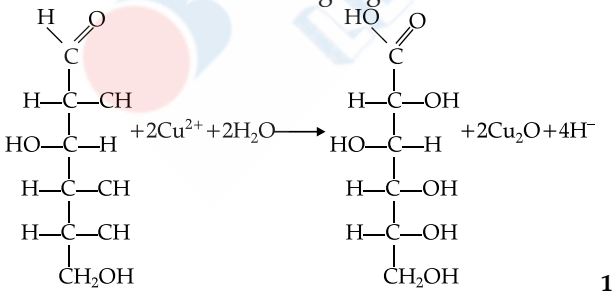
$t = 230.3 \log 5$ ($\log 5 = 0.6990$)

$t = 160.9$ min ½

20. **(a)** Acetylation of glucose with acetic anhydride gives glucose pentaacetate which confirms the presence of five –OH groups. Since, it exists as a stable compound, five –OH groups should be attached to different carbon atoms. **1**



(b) Glucose reduces Fehling's reagent. Thus, it is considered as reducing sugar.



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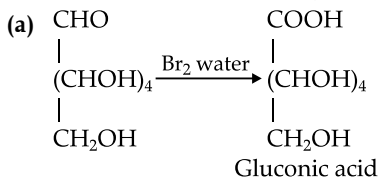
OR

(a)



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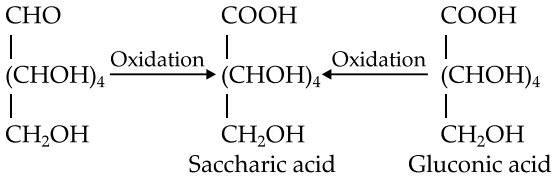
(b)



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21. **(a)** At the *ortho* position, higher steric hindrance is there, hence *para* isomer is usually predominate and is obtained in the major amount. **1**

(b) During the S_N1 mechanism, intermediate carbocation formed is sp^2 hybridised and planar in nature. This allows the attack of nucleophile from either side of the plane resulting in a racemic mixture. **1**

OR

(a) *Tert*-butyl alcohol or 2-methyl propan-2-ol using Lucas reagent , mixture of conc.HCl and $ZnCl_2$ the reaction will follow the S_N1 pathway. **1**

(b) Chloromethane is having higher dipole moment. Due to smaller size of fluorine the dipole moment of flouromethane is comparatively lesser. **1**

22. $[Co(NH_3)_5CO_3]Cl$ and $[Co(NH_3)_5Cl]CO_3$ ½ + ½

Pentaaminecarbonatocobalt(III)chloride ½

Pentaaminechloridocobalt(III)carbonate ½

23. **Anode:** $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$ ½

Cathode: $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$. ½

Overall: $2Zn(s) + O_2(g) + 2H_2O(l) \rightarrow 2\ Zn^{2+}(aq) + 4OH^-(aq)$

$2\ Zn\ (s) + O_2(g) + 2H_2O(l) \rightarrow 2\ Zn(OH)_2(ppt)$ **1**

24. **(a)** The rate of reaction will increase. The catalyst decreases the activation energy of the reaction therefore the reaction becomes faster. ½ + ½

(b) The rate of reaction will decrease with the decrease in temperature. At lower temperatures, the kinetic energy of molecules decreases thereby the collisions decrease resulting in a lowering of rate of reaction. ½ + ½

25. $(CH_3)_2CHCHO + C_2H_5MgBr \xrightarrow{\text{dry ether}}$

2-methyl propanal

$(CH_3)_2CHCH(C_2H_5)(OMgBr)$ **1**

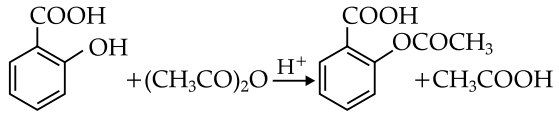
$(CH_3)_2CHCH(C_2H_5)(OMgBr) \xrightarrow{H^+/H_2O}$

$(CH_3)_2CHCH(C_2H_5)(OH)$

2-Methylpentan-3-ol **1**

Section - C

26. **(a)** When a mixture of salicylic acid, acetic anhydride and acetic acid is refluxed then aspirin is formed as a product. This reaction is very slow and produces low yield. **1**



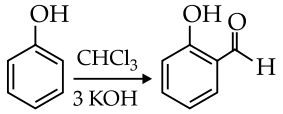
Salicylic acid Acetylsalicylic acid (Aspirin)

(b) This is elimination reaction.

$(CH_3)_3CCl \xrightarrow{\text{Sodium ethoxide}} (CH_3)_2C = CH_2$

tert-butyl chloride 2methylpropene **1**

(c) *o*-hydroxybezaldehyde will be formed. This is Reimer-Tiemann reaction. **1**



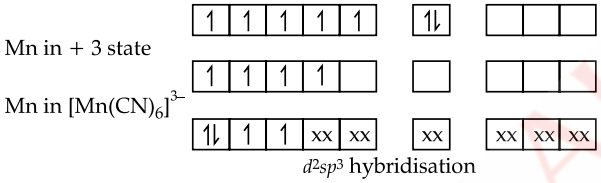
Salilcylaldehyde

27. $[Mn(CN)_6]^{3-}$

$Mn = [Ar]\ 3d^5 4s^2$

$Mn^{3+} = [Ar]\ 3d^4$

Mn (ground state)



xx are electrons donated by ligand CN^-

Type of hybridisation – d^2sp^3 **1**

Magnetic moment value

$= \sqrt{n(n+2)} = \sqrt{2(2+2)} = 2.87$ BM

(n = no. of unpaired electrons) **1**

Type of complex – inner orbital **1**

28. **(a) Henry's law:** The partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution. **1**

The pressure underwater is high, so the solubility of gases in blood increases. When the diver comes to surface the pressure decreases so does the solubility causing bubbles of nitrogen in blood, to avoid this situation and maintain the same partial pressure of nitrogen underwater too, the dilution is done. **1**

(b) $p = K_H x$

Mole fraction of argon in water,

$$x = \frac{p}{K_H} = \frac{6}{40} \times 10^3$$

$$= 1.5 \times 10^{-4}$$ **1**

29. **(any 3)**

(a) Aniline is acetylated, before nitration reaction in order to avoid formation of tarry oxidation products and protecting the amino group, so that *p*-nitro derivative can be obtained as major product. **1**

(b) pK_b of aniline is lower than the *m*-nitroaniline. The basic strength of aniline is more that *m*-nitroaniline. The pk_b value is inversely proportional to the basic strength. The presence of electron withdrawing group decreases basic strength. **1**

(c) Due to the presence of acidic hydrogen in the N-alkylbenzenesulphonamide formed by the treatment of primary amines. **1**

(d) Aniline does not react with methylchloride in the presence of $AlCl_3$ catalyst , because aniline is a base and $AlCl_3$ is lewis acid which lead to the formation of salt. **1**

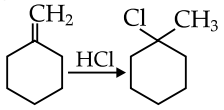
30. **(a)** The major product formed when 2-cyclohexyl-chloroethane undergoes dehydrohalogenation reaction is 1-cyclohexylethene. The reagent which is used to carry out the reaction is ethanolic KOH.

1 + 1

(b) Haloalkanes are more reactive than haloarenes and vinylic halides because of the presence of partial double bond character C-X bond in haloarenes and vinylic halides. Hence, they do not undergo nucleophilic reactions easily. **1**

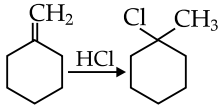
OR

(a) Methylenecyclohexane



½ + ½

1-Methylcyclohexene



½ + ½

(b) Allyl chloride shows high reactivity as the carbocation formed in the first step is stabilised by resonance while no such stabilisation of carbocation exists in the case of *n*-propyl chloride. **1**

Section - D

31. **(a)** A = 100 so, T = 100
C = 150 so, G = 150
Total nucleotides = 100 + 100 + 150 + 150 = 500 **1**

(b) They studied the nucleotide composition of DNA. It was the same so, they concluded that the samples belong to same species. **1**

(c) A = T = 20%
But G is not equal to C so double helix is ruled out. ½

The bases pairs are ATGC and not AUGC so it is not RNA. ½

The virus is a single helix DNA virus. **1**

OR

According to Charagraff rule, all double helix DNA will have the same amount of A and T as well as C will be same amount as G. If this is not the case then the helix is single stranded. **2**

32. The melting point of ice is the freezing point of water. We can use the depression in freezing point property in this case.

(a) 3rd reading for 0.5 g there has to be an increase in depression of freezing point and therefore decrease in freezing point so also decrease in melting point when amount of salt is increased but the trend is not followed on this case. **1**

(b) Two sets of reading help to avoid error in data collection and give more objective data. **1**

(c) $\Delta T_f\,(\text{glucose}) = 1 + K_f \times \frac{0.6 \times 1000}{180 \times 10}$ ½

$$\Delta T_{f(\text{NaCl})} = 2 + K_f \times \frac{0.6 \times 1000}{58.5 \times 10}$$

$$3.8 = 2 + K_f \times \frac{0.6 \times 1000}{58.5 \times 10}$$ ½

Divide equation 1 by 2

$$\frac{\Delta T_f(\text{glucose})}{3.8} = \frac{58.5}{2 + 180}$$

ΔTf (glucose) = 0.62 ½

Freezing point or Melting point = –0.62 °C ½

OR

Depression in freezing point is directly proportional to molality (mass of solute when the amount of solvent remains same). **1**

0.3 g depression is 1.9 °C.

0.6 g depression is 3.8 °C.

1.2 g depression will be 3.8 × 2 = 7.6 °C. **1**

Section - E

33. **(a)** The cell potential remains constant during its life as the overall reaction does not involve any ion in solution whose concentration can change during its life time. **1**

(b) $KCl\,(aq) \rightarrow K^+\,(aq) + Cl^-\,(aq)$

Cathode: $H_2O(l) + e^- \rightarrow \frac{1}{2} H_2\,(g) + OH^-\,(aq)$ ½

Anode: $Cl^-\,(aq) \rightarrow \frac{1}{2} Cl_2\,(aq) + e^-$ ½

Net reaction:

$KCl\,(aq) + H_2O\,(l) \rightarrow K^+\,(aq) + OH^-\,(aq) + \frac{1}{2} H_2\,(g) + \frac{1}{2} Cl_2\,(g)$ **1**

(c) Given, potential of hydrogen gas electrode = −0.59 V

Electrode reaction: $H^+ + e^- \rightarrow 0.5\,H_2$

Applying Nernst equation,

$$E_{(H^+/H_2)} = E^\circ_{H^+/H_2} - \frac{0.059}{n} \log \frac{[H_2]^{1/2}}{[H^+]}$$ **1**

$$E^\circ_{H^+/H_2} = 0\ \text{V}$$

$$E_{(H^+/H_2)} = -0.59\ \text{V}$$

$$n = 1$$

$$[H_2] = 1\ \text{bar}$$

Substituting values,

$$-0.59 = 0 - 0.059\,(-\log [H^+])$$ ½

$$-0.59 = -0.059 \times \text{pH}$$

$$\therefore \quad \text{pH} = 10$$ ½

OR

(a) "A" is copper, metals are conductors thus have high value of conductivity. **1**

(b) $Mg^{2+} + 2e^- \rightarrow Mg$

1 mole of magnesium ions gains two moles of electrons or 2F to form 1 mole of Mg.

24 g Mg requires 2 F electricity

4.8 g Mg requires 2 × 4.8/24

= 0.4 F

= 0.4 × 96500

= 38600C **1**

$Ca^{2+} + 2e^- \rightarrow Ca$

2 F electricity is required to produce 1 mole = 40 g Ca

0.4 F electricity will produce 8 g Ca **1**

(c) F = 96500 C, $n = 2$,

$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s) \quad -0.14V$

$Cu^{2+}(aq) + e^- \rightarrow Cu^+(aq) \quad 0.15\ V$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= 0.15 - (-0.14) = 0.29V$ **1**

$\Delta G^o = -nFE^\circ_{cell}$

$= -2 \times 96500 \times 0.29$

$= 55970\ J/mol$ **1**

34. A is an alkene.

B is an aldehyde with $-CH_3$ group

C is a methyl ketone

$CH_3CHO + [Ag(NH_3)_2]^+ + OH^- \ CH_3COO^- + Ag^+ + NH_3 + H_2O$ ½

$CH_3COCH_3 + NaOH + I_2 \rightarrow CHI_3 + CH_3COO\text{-}Na$ ½

A: $CH(CH_3) = C(CH_3)_2$

B: CH_3CHO

C: $O = C(CH_3)_2$ **(1.5 = ½ each)**

$CH_3COCH_3 + CH_3CHO$

$\downarrow Ba(OH)_2$

$(CH_3)_2C(OH)CH_2COCH_3 + CH_3CH(OH)CH_2CHO + (CH_3)_2C(OH)CH_2CHO + CH_3CH(OH)CH_2OCH_3$

$\downarrow$ heat

$(CH_3)_2C{=}CHCOCH_3 + CH_3CH{=}CHCHO + (CH_3)_2C = CHCHO + CH_3CH = CHCOCH_3$

(2.5 = ½ mark for each product, ½ for the reaction)

OR

(a) (A): CCl_3COOH (B): CH_3COOH **1**

(b) $CH_3COOH \xrightarrow[(ii)\ H_2O]{(i)\ Red\ P/Cl_2} CCl_3COOH$,

Hell Volhard Zelinsky reaction ½ + ½

(c) $CH_3COCl \xrightarrow{H_2O} CH_3COOH$ **1**

(d) A will be more acidic due to presence of 3 Cl groups (electron withdrawing groups) which increase acidity of carboxylic acid. **1**

(e) $CH_3COOH \xrightarrow{(i)\ NaOH,\ CaO\ (i)\ heat} CH_4 + Na_2CO_3$ **1**

35. **(a)** Cu^{2+} oxidises iodide ion to iodine.

$2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$ **1**

(b) The low value for V is related to the stability of V^{2+} (half-filled t_{2g} level) **1**

(c) Permanganate titrations in presence of hydrochloric acid are unsatisfactory since, hydrochloric acid is oxidised to chlorine. **1**

(d) The *d* orbital is fully-filled and shield the electrons present in the higher *s*-orbital to a greater extent resulting, increase in size. **1**

(e) The chromates and dichromates are interconvertible in aqueous solution depending upon pH of the solution. Increasing the pH (in basic solution) of dichromate ions a colour change from orange to yellow is observed as dichromate ions change to chromate ions. **1**

■■■