SAMPLE PAPER (2022-23)

CHEMISTRY THEORY

(043)

MM:70 **Time: 3 hours**

General Instructions:

Read the following instructions carefully.

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

b) SECTION A consists of 18 multiple-choice questions carrying 1 mark each.

c) SECTION B consists of 7 very short answer questions carrying 2 marks each.

d) SECTION C consists of 5 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 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. $C_6H_5CH(CH_3)\ Br$

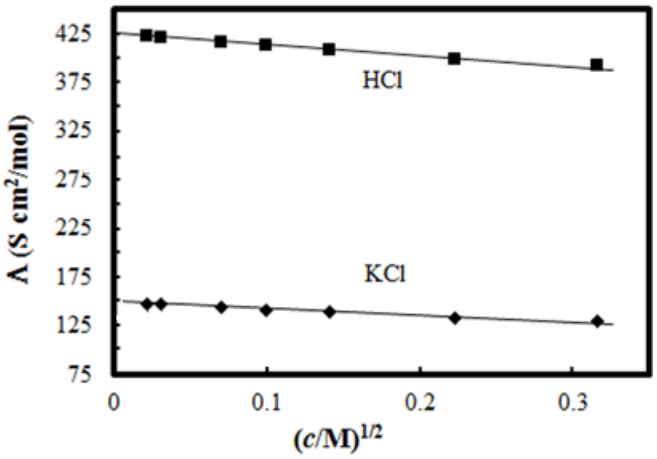
3. $KMnO_4$ is coloured due to:

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

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



   a. 100 Scm^2/mol
   b. 115 Scm^2/mol
   c. 150 Scm^2/mol
   d. 125 Scm^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 $51.12 \times 10^{-4}\ Scm^2/mol$ and $73.54 \times 10^{-4}\ Scm^2/mol$ respectively?

   a. 124.66 Scm^2/mol
   b. 22.42 Scm^2/mol
   c. 198.20Scm^2/mol
   d. 175.78 Scm^2/mol

6. For the reaction, A +2B → AB_2, the order w.r.t. reactant A is 2 and w.r.t. reactant B. 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- Etthylethanaminamine

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_6H5 + HBr → A + B

a. A= $C_6H_5CH_2OH$, B= C_6H_6
b. A=$C_6H_5CH_2OH$,B= C6H5Br
c. A=$C_6H_5CH_3$,B= C_6H_5Br
d. A=$C_6H_5CH_2Br$, B= C_6H_5OH

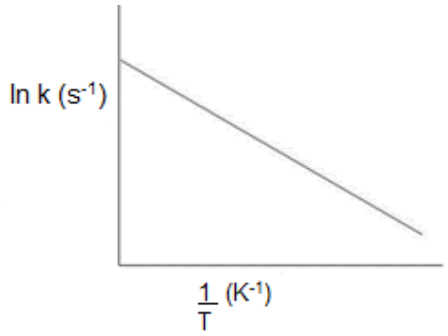
10. Which of the following statements is not correct for amines?

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) Ea/R
b. (i) A (ii) Ea
c. (i)ln A (ii) - Ea/R
d. (i) A (ii) -Ea

***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

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

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

Reason (R): Ethers are polar in nature.

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)

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 stabilized by hydrogen bonding.

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.

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

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

Reason : Actinide elements are strongly paramagnetic.

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.

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

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.

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 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 hybridization
    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 = 40kbar)

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	Reading 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 0^{o}C, 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 $E^o_{(V^{3+}/V^{2+})}$ 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?

SAMPLE PAPER (2022-23)

CHEMISTRY THEORY (043)

MARKING SCHEME

SECTION A

Q1 to 18 each correct answer 1 mark

1. b. 1-methylcyclohexene
   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.

2. c $C_6H_5CH(C_6H_5)Br$
   $C_6H_5CH(C_6H_5)^+$ carbocation formed is more stable

3. b. charge transfer from ligand to metal
   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 due to L→M (ligand to metal) charge transfer 2p(L) of O to 3d(M) of Mn.

4. a. ^{15}O
   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. b. 115 Scm^2/mol
   $\Lambda^O CH_3COOK = \Lambda^O CH3COOH + \Lambda^O KCl - \Lambda^O HCl = 390 + 150 - 425 = 115\ Scm^2/mol$

5* (For visually challenged learners)

a. $124.66 \times 10^{-4}\ Sm^2mol^{-1}$
   Molar conductance of NaCl = $\lambda^+_{Na} + \lambda^+_{Cl}$
   $= 51.12\times10^{-4} + 73.54\times10^{-4}$
   $= 124.66 \times10^{-4}\ Sm^2mol^{-1}$

6. a. increases 4 times
   Rate = $[A]^2$
   If [A] is doubled then Rate' = $[2A]^2 = 4\ [A]^2 = 4$ Rate

7. d. B<C<A
   In primary amine intermolecular association due to H-bonding is maximum while in tertiary it is minimum.

8. b. 8000 cm^{-1}

Δt =(4/9) x 18000cm-1 =8000 cm^{-1}

9. d. A.=$C_6H_5CH_2Br$, B = C_6H_5OH,

$C_6H_5CH_2OC_6H_5$ H+ $C_6H_5CH_2OC_6H_5$

10. c. CH_3NH_2 on reaction with nitrous acid releases NO_2 gas
Wrong statement . The evolution of nitrogen gas takes place.

11. c. 2,4 DNP test
Fehling's, Tollen's and Cannizzao reaction is shown by alcohols only.

12. c.(i)ln A (ii) - Ea/R

12* (For visually challenged learners)

d. $mol^{-2}\ L^2\ s^{-1}$ since the order of reaction is 3.

13. c. 5
1Fe^{2+}, 2 SO_4^{2-} and 2 NH_4^+ ions

14. A Etard reaction

15. b Both A and R are true but R is not the correct explanation of A.
A and R are two different statements about ethers
The correct reason is that hydrogen bonding does not exist amongst ether molecules.

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

17. b Both A and R are true but R is not the correct explanation of A.
The magnetic moment is less as the 5f 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. a Both A and R are true and R is the correct explanation of A.

SECTION B

19. Half life t1/2 = 0.693 /k
k= 0.693/69.3 = 1/100 = 0.01 min^{-1} (1/2)
For first order reaction

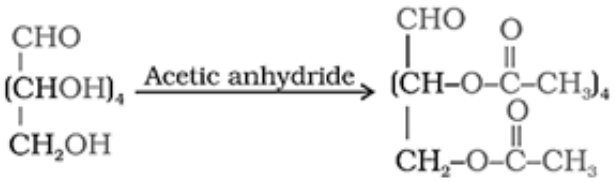
$$k = \frac{2.303}{t}\ log\frac{[Ro]}{[R]}$$ (1)

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

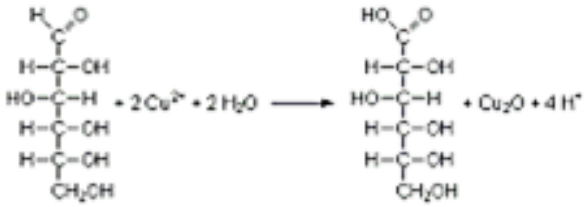
$t = 230.3 \log 5$ (log 5 =0.6990)

t= 160.9 min (1/2)

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)



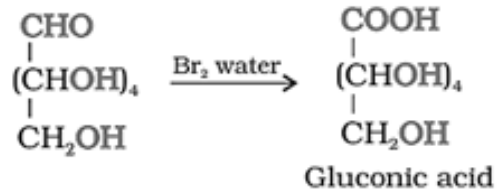
b.Glucose reduces Fehlings reagent



(1)

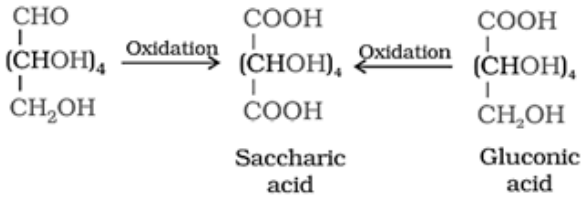
OR

a.



(1)

b.



(1)

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 hybridized 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 concHCl 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 $[Co(NH_3)_5Cl]CO_3$ (1/2+1/2)
Pentaaminecarbonatocobalt(III)chloride (1/2)
Pentaaminechloridocobalt(III)carbonate (1/2)

23. Anode: Zn (s) → Zn^{2+} (aq) + 2 e- (1/2)

Cathode: $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-$ (aq). (1/2)

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

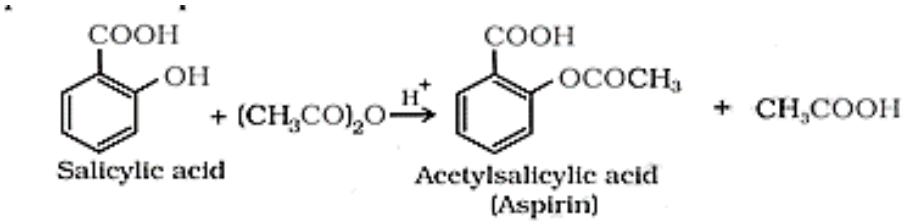
2 Zn (s) + $O_2(g)$ + $2H_2O(l)$ → 2 $Zn(OH)_2$ (ppt) (1)

24. The rate of reaction will increase. The catalyst decreases the activation energy of the reaction therefore the reaction becomes faster. (1/2+1/2)
b.The rate of reaction will decrease. At lower temperatures the kinetic energy of molecules decreases thereby the collisions decrease resulting in a lowering of rate of reaction. (1/2+1/2)

25. $(CH_3)_2CHCHO + C_2H_5MgBr \xrightarrow{\text{dry ether}} (CH_3)_2CHCH(C_2H_5)(OMgBr)$
$(CH_3)_2CHCH(C_2H_5)(OMgBr) \xrightarrow{H^+/H_2O} (CH_3)_2CHCH(C_2H_5)(OH)$ (1)
2-Methylpentan-3-ol (1)

SECTION C

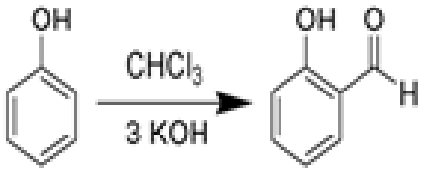
26. (i) Aspirin is formed



(1)

(ii) $(CH_3)_3CCl \xrightarrow{\text{sodium ethoxide}} (CH_3)_2C=CH_2$
2methylpropene (1)

(iii) o-hydroxybezaldehyde will be formed



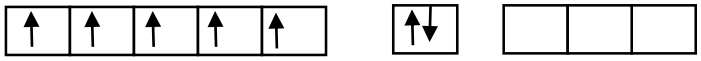
(1)

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

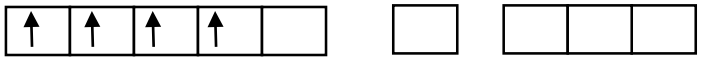
Mn = [Ar] $3d^5 4s^2$

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

Mn (ground state)



Mn in +3 state



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

d^2sp^3 hybridisation

xx are electrons donated by ligand CN^-

Type of hybridization – 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 $x = p/k = 6/ 40 \times 10^3 = 1.5 \times 10^{-4}$ (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.pKb of aniline is lower than the m-nitro aniline.The basic strength of aniline is more that m-nitroaniline . pkb value is inversely proportional to basic strength. Presence of Electron withdrawing group decrease 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 formation of salt. (1)

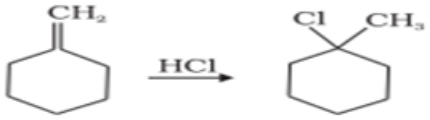
30.

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

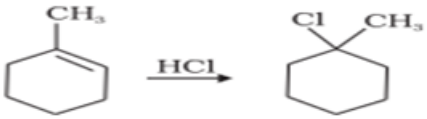
b. Haloalkanes are more reactive than haloarenes and vinylic halides because of the presence of partial double bond character C-X bond in haloarenes and vinylic halides. Hence they do not undergo nucleophilic reactions easily. (1)

OR

a. Methylenecyclohexane



1-Methylcyclohexene (1/2+1/2)



(1/2+1/2)

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. (1/2)

The bases pairs are ATGC and not AUGC so it is not RNA (1/2)

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. ΔT_f (glucose) = $1 \times K_f \times \frac{0.6 \times 1000}{180 \times 10}$ (1/2)

ΔT_f (NaCl) = $2 \times K_f \times \frac{0.6 \times 1000}{58.5 \times 10}$ (1/2)

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

Divide equation 1 by 2

$\frac{\Delta T_f \text{ (glucose)}}{3.8} = \frac{58.5}{2 \times 180}$ (1/2)

ΔT_f (glucose = 0.62 Freezing point or Melting point = - 0.62 ^oC (1/2)

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 ^oC

0.6 g depression is 3.8 ^oC

1.2 g depression will be 3.8 x2 = 7.6 ^oC (1)

SECTION E

33. 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: $H_2O(l) + e^- \rightarrow \frac{1}{2} H_2 (g) + OH^- (aq)$ (1/2)

anode: $Cl^- (aq) \rightarrow \frac{1}{2} Cl_2 (aq) + e^-$ (1/2)

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,

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

$E^o (H^+/H_2) = 0$ V

$E (H^+/H_2) = -0.59$ V

$n = 1$

$[H_2] = 1$ bar

$-0.59 = 0 - 0.059 (- \log [H^+])$ (1/2)

$-0.59 = -0.059pH$

$\therefore pH = 10$ (1/2)

OR

a. “A” is copper, metals are conductors thus have high value of conductivity. (1)
b. $Mg^{2+} + 2e^-$ à 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 x4.8/24 = 0.4 F = 0.4 x96500 = 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 = 96500C, n=2,

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

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

$E^o cell = E^o cathode – E^o anode$

= 0.15 – (-0.14) = 0.29V (1)

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

= -2 x96500x 0.29 = 55970 J/mol (1)

34. A is an alkene

B is an aldehyde with $–CH_3$ group

C is a methyl ketone

$CH_3CHO + [Ag(NH_3)_2]^+ + OH^- \longrightarrow CH_3COO^- + Ag + NH_3 + H_2O$ (1/2)

$CH_3COCH_3 + NaOH + I_2 \longrightarrow CHI_3 + CH_3COONa$ (1/2)

A : $CH(CH_3)=C(CH_3)_2$ B: CH_3CHO C: $O=C(CH_3)_2$ (1.5 = 1/2 each)

$CH_3COCH_3 + CH_3CHO$

$\downarrow$ $Ba(OH)_2$

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

$\downarrow$ heat

$(CH_3)_2C=CHCOCH_3 + CH_3CH=CHCHO + (CH_3)_2C=CHCHO + CH_3CH=CHCOCH_3$ (2.5 = 1/2 mark for each product, ½ for the reaction)

OR

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

b. CH_3COOH (i)Red P / Cl_2 CCl_3COOH, Hell Volhard Zelinsky reaction (1/2 +1/2)
(ii)H_2O

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 (i)NaOH, CaO (ii) heat $\longrightarrow$ $CH_4 + Na_2CO_3$ (1)

35. a. Cu^{2+} oxidizes iodide ion to iodine. (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.

d. The d orbital is full with ten electrons and shield the electrons present in the higher s-orbital to a greater extent resulting in increase in size.

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.