CBSE Class 12 Chemistry
Sample paper 02 (2020-21)

Maximum Marks: 70
Time Allowed: 3 hours

General Instructions:

a. There are 33 questions in this question paper. All questions are compulsory.
b. Section A: Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
c. Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
d. Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
e. Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
f. There is no overall choice. However, internal choices have been provided.
g. Use of calculators and log tables is not permitted.

Section A

1. **Read the passage given below and answer any four out of the following questions:**
   Nitrogen differs from the rest of the members of group 15 due to its smaller size, high electronegativity, high ionisation enthalpy, and non-availability of d orbitals. Nitrogen has a unique ability to form pπ-pπ multiple bonds with itself. Nitrogen exists as a diatomic molecule with a triple bond one s and two p between the two atoms. Phosphorus, arsenic and antimony from single bonds as P–P, As–As and Sb–Sb while bismuth forms metallic bonds in an elemental state. Dinitrogen is produced commercially by the liquefaction and fractional distillation of air. Liquid dinitrogen (b.p. 77.2 K) distils out first leaving behind liquid oxygen (b.p. 90 K). In the laboratory, dinitrogen is prepared by treating an aqueous solution of ammonium chloride with sodium nitrite. Dinitrogen is a colourless, odourless, tasteless and non-toxic gas. It has two stable isotopes 14N and 15N. It has very low solubility in water. The main use of dinitrogen is in the manufacture of ammonia and other industrial chemicals containing nitrogen.
   The following questions are multiple-choice questions. choose the most appropriate answer

i. N–N bond is weaker than the single P–P bond because
   a. high interelectronic repulsion of the bonding electrons
   b. high interelectronic repulsion of the non-bonding electrons
   c. no repulsion between bonding electrons
   d. no repulsion between non-bonding electrons

ii. Very pure nitrogen can be obtained by the
   a. thermal decomposition of sodium
   b. thermal decomposition of barium azide
   c. thermal decomposition of ammonium dichromate
   d. both (a) and (b)

iii. Dinitrogen is rather inert at room temperature because of
   a. low bond enthalpy of $N\equiv N$ bond
   b. high bond enthalpy of $N\equiv N$ bond
   c. low freezing point
   d. low boiling point

iv. Dinitrogen combines with dioxygen only at very high temperature (at about 2000 K) to form
   a. nitric oxide
   b. nitrate
   c. nitrites
   d. nitric acid

v. Liquid dinitrogen is used as a refrigerant to
   a. preserve biological materials
   b. preserve food items
   c. in cryosurgery
   d. all of these

2. **Read the passage and answer any four out of the following questions:**

Colloidal particles always carry an electric charge. The nature of this charge is the same on all the particles in a given colloidal solution and may be either positive or negative. The charge on the sol particles is due to one or more reasons, viz., due to electron capture by sol particles during electrodispersion of metals. When two or more ions are present in the dispersion medium, preferential adsorption of the ion common to the colloidal particle usually takes place. When silver nitrate solution is added to the potassium iodide solution, the precipitated silver iodide adsorbs iodide ions from the dispersion medium, and negatively charged colloidal solution results. acquired a positive or a negative charge by selective adsorption on the surface of a colloidal particle The combination of the two layers of opposite charges around the colloidal particle is called Helmholtz electrical double layer. The presence of equal and similar charges on colloidal particles is largely responsible for providing stability to the colloidal solution.

In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

a. Assertion and reason both are correct statements and reason is correct explanation for assertion
b. Assertion and reason both are correct statements but reason is not correct explanation for assertion
c. Assertion is correct statement and reason is wrong statement
d. Assertion is wrong statement but reason is correct statement

i. **Assertion:** The presence of equal and similar charges on colloidal particles is largely responsible in providing stability to the colloidal solution.
   Reason: The repulsive forces between charged particles having the same charge prevent them from aggregating and provide stability.
ii. **Assertion:** The first layer is mobile in Helmholtz electrical double layer.
   Reason: The potential difference between the fixed layer and the diffused layer of opposite charges is called zeta potential.
iii. **Assertion:** The sol particle in colloid has a charge.
   Reason: The charge in sol is due to electron capture by sol particles during the electrodispersion of metals.
iv. **Assertion:** Methylene blue sol is a negatively charged sol.
   Reason: When KI solution is added to $AgNO_3$ solution, positively charged sol formed.
v. **Assertion:** If FeCl3 is added to an excess of hot water, a positively charged sol of hydrated ferric oxide is formed.
   Reason: When ferric chloride is added to NaOH a negatively charged sol is obtained with adsorption of OH- ions.

3. Methylamine reacts with HNO_2 to form _______.

a. CH_3-O-N=O

b. CH_3CHO

c. CH_3-O-CH_3

d. CH_3OH

4. Insulin is a protein which contains ______ amino acids

a. 70

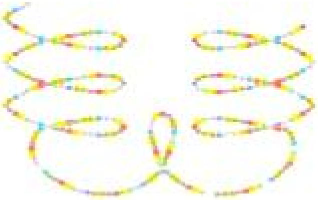
b. 51

c. >100

d. 120

OR

The following structure of protein is called



a. quaternary structure

b. Secondary structure

c. Tertiary structure

d. primary structure

5. The osmotic pressure of a solution containing 0.02 mole of solute at 300 K will be:

a. $0.02 \times 0.0821 \times 300\ atm$

b. $\frac{0.02 \times 300}{0.0821} atm$

c. $0.02 \times 0.821 \times 300\ atm$

d. $\frac{0.02 \times 0.0821}{300} atm$

6. A mixture containing two enantiomers in equal proportions:

a. will be called a racemic mixture

b. will be called a racemic mixture and will have a zero optical rotation.

c. will have inverted configuration

d. will have zero optical rotation

OR

Ethyl benzene cannot be prepared by _______.

a. Clemmensen reduction

b. Wurtz – Fittig reaction
c. Friedel – Crafts reaction
d. Wurtz reaction

7. Hoffmann Bromamide Degradation reaction is shown by _______.
   a. $ArNH_2$
   b. $ArCONH_2$
   c. $ArNO_2$
   d. $ArCH_2NH_2$

OR

Which of the following respond to the isocyanide test?
   a. Primary amines
   b. Tertiary amines
   c. Primary and secondary amines
   d. Secondary amines

8. Which complex gives three chloride ions per formula unit?
   a. $CrCl_3 . 5H_2O$
   b. $CrCl_3 . 6H_2O$
   c. $CrCl_3 . 4H_2O$
   d. All of these

OR

Which of the following complexes can form d and l isomers?
   a. Trans - $[Co(en)_2Cl_2]^+$
   b. $[Co(NH_3)_3Cl_3]$
   c. Cis - $[Co(en)_2Cl_2]^+$
   d. $[Co(NH_3)_4Cl_2]^+$

9. In which of the following compounds, the cemtcen metal atom/ion is in the lowest oxidation state?
   a. $[Co(NH_3)_5Br]_2SO_4$

b. $Mn_2(CO)_{10}$

c. $Fe_3[Fe(CN)_6]_2$

d. $K[PtCl_3(C_2H_4)]$

10. Which of the following is an example of vic-dihalide?
    a. 1, 2-dichloroethane
    b. Dichloromethane
    c. Ethylidene chloride
    d. Allyl chloride
11. What type of interaction hold the molecules together in a polar molecular solid?
    a. London forces
    b. Hydrogen bonding
    c. Dipole - dipole interaction
    d. Metallic bonding
12. **Assertion:** $[Ni(CO)_4]$ is diamagnetic complex.

    Reason: It involves sp^3 hybridisation and there is no unpaired electron.
    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Assertion is INCORRECT but, reason is CORRECT.
13. **Assertion:** Insulin is a globular protein.
    Reason: Gum is a polymer of more than one type of monosaccharides.
    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Assertion is INCORRECT but, reason is CORRECT.
14. **Assertion:** Molarity of a solution in liquid state changes with temperature.
    Reason: The volume of a solution changes with a change in temperature.
    a. Assertion and reason both are correct statements and reason is the correct

explanation for the assertion.

b. Assertion and reason both are correct statements but the reason is not the correct explanation for the assertion.
c. Assertion is correct statement but reason is wrong statement.
d. Assertion and reason both are incorrect statements.

OR

Assertion: ΔH_{mix} and ΔV_{mix} are zero for the ideal solution.

Reason: The interactions between the particles of the components of a solution are almost identical as between particles in the liquids.

a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
c. Assertion is CORRECT but, reason is INCORRECT.
d. Assertion is INCORRECT but, reason is CORRECT.

15. **Assertion:** Boiling points of alcohols and ethers are high.

Reason: They can form intermolecular hydrogen-bonding.

a. Assertion and reason both are correct and the reason is the correct explanation of assertion.
b. Assertion and reason both are wrong statements.
c. The assertion is a correct statement but the reason is the wrong statement.
d. The assertion is a wrong statement but the reason is the correct statement.

16. **Assertion:** 1-Iodopropane and 2-iodopropane are chain isomers.

Reason: These differ in the position of I in the carbon chains.

a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
c. Assertion is CORRECT but, reason is INCORRECT.
d. Assertion is INCORRECT but, reason is CORRECT.

Section B

17. Suggest a possible reason for the following observations:

i. The order of reactivity of haloalkanes is RI > RBr > RCI.

ii. neo-pentyl chloride, $(CH_3)_3C\text{-}CH_2Cl$ does not follow S_N2 mechanism.

OR

Write the structure of the major organic product in the following reaction:

$CH_3CH_2CH_2OH + SOCl_2 \rightarrow$

18. A 5% solution (by mass) of cane sugar ($M \cdot W$342) is isotonic with 0.877% solution of substance X. Find the molecular weight of X.

19. Give IUPAC name of linkage isomer of $[(NH_3)_3Pt(NO_2)]Cl$.

OR

What is crystal field splitting energy?

20. Calculate the half life of first order reaction whose rate constant is $200 s^{-1}$.

21. At 298K, the rate of the chemical reaction doubles on increase of temperature by 10 K. Calculate E_a of this reaction.

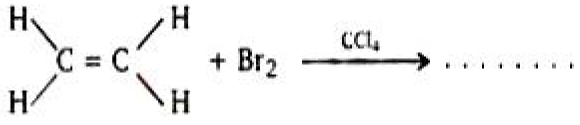
22. Arrange the following compounds in increasing order of their acid strength.

Propane - 1-ol, 2, 4, 6 - trinitrophenol, 3-nitrophenol, 3 , 5-dinitrophenol, 4-methyl, phenol.

23. Although Cr^{3+} and Co^{2+} ions have same number of unpaired electrons but the magnetic moment of Cr^{3+} is 3.87 B.M. and that of Co^{2+} is 4.87 B.M. Why?

24. Complete the following reaction equation:

i. $C_6H_5N_2^+Cl^+ + KI \rightarrow$ ....

ii. 

25. What is the two dimensional coordination number of a molecule in square close-packed layer?

Section C

26. Draw the structure of H_3PO_2 .

OR

Draw the structural formulae of the following:

1. BF_3
2. Peroxodisulphate ion ($S_2O_9^-$)
3. XeF_4

27. Give one chemical test to distinguish between primary, secondary and tertiary amines.

OR

Write structures of different isomers corresponding to the molecular formula C_3H_9N.

Write IUPAC names of the isomers which will liberate nitrogen gas on treatment with nitrous acid.

28. Silver crystallizes in fcc lattice. If edge length of the cell is $4.077 \times 10^{-8} cm$ and density is 10.5 g cm^{-3}.Calculate the atomic mass of silver.

29. Define having an aldehyde group:
    i. Glucose does not give 2, 4-DNP test. What does this indicate?
    ii. Draw the Haworth structure of a - D - (+) - Glucopyranose.
    iii. What is the significance of D and (+) here?

30. How the following conversions can be carried out?
    i. 2-Bromopropane to 1-bromopropane
    ii. Chloroethane to butane
    iii. Benzene to diphenyl

Section D

31. i. Give reasons for the following observations.
        a. Cu+ ion is not stable in aqueous solution.
        b. Mn(II) ion shows maximum paramagnetic character amongst the bivalent ions of first transition series.
        c. Scandium(Z = 21) salts are white.
    ii. Describe the reactions involved in the preparation of $K_2Cr_2O_7$ from chromite ore.

OR

On the basis of Lanthanoid contraction, explain the following:

i. Nature of bonding in La_2O_3 and Lu_2O_3 .
ii. Trends in the stability of oxo salts of lanthanoids from La to Lu.
iii. Stability of the complexes of lanthanoids.

iv. Radii of 4d and 5d block elements.

v. Trends in the acidic character of lanthanoid oxides.

32. Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions.

i. Ethanal, Propanal, Propanone, Butanone.

ii. Benzaldehyde, p-Tolualdehyde, p-Nitrobenzaldehyde, Acetophenone.

Hint: Consider steric effect and electronic effect.

OR

i. Write the products formed when CH_3CHO reacts with the following reagents:

  a. HCN

  b. $H_2N\text{-}OH$

  c. CH_3CHO in the presence of dilute NaOH

ii. Give simple chemical tests to distinguish between the following pairs of compounds:

  a. Benzoic acid and phenol

  b. Propanal and propanone

33. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

OR

a. Explain with one example each the terms weak and strong electrolytes.

b. Write the Nernst equation and calculate the emf of the following cell.

$Fe(s) \,||\, Fe^{2+}(0.001\ M) \,||\, H^{+}(1M)|H_2(g)|Pt(s)(1\ bar)$

$E^0(Fe^{2+}/Fe) = -0.44V$

CBSE Class 12 Chemistry
Sample paper 02 (2020-21)

Solution

Section A

1.
   i. (b) high interelectronic repulsion of the non-bonding electrons
   ii. (d) both (a) and (b)
   iii. (b) high bond enthalpy of N≡N bond
   iv. (a) nitric oxide
   v. (d) all of these
2.
   i. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion
   ii. (d) Assertion is wrong statement but Reason is correct statement
   iii. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion
   iv. (d) Assertion is wrong statement but reason is correct statement
   v. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
3. (d) CH_3OH

   Explanation: $CH_3NH_2 + HNO_3 \xrightarrow{0^\circ - 5^\circ C} CH_3OH + N_2 + H_2O$
4. (b) 51

   Explanation: Insulin contain 51 amino acids

   OR

   (c) Tertiary structure

   Explanation: This structure represents tertiary structure of proteins. The tertiary structure of proteins represents overall folding of the polypeptide chains i.e., further folding of the secondary structure.
5. (a) $0.02 \times 0.0821 \times 300\ atm$

   Explanation: $0.02 \times 0.0821 \times 300\ atm$

   since OP= CRT
6. (b) will be called a racemic mixture and will have a zero optical rotation.

Explanation: **Enantiomers** are chiral molecules that are mirror images of one another. Furthermore, the molecules are non-superimposable on one another. This means that the molecules cannot be placed on top of one another and give the same arrangement of atoms in space. If they are present in equal proportions, the mixture is called a racemic mixture and it is optically inactive, as one isomer will rotate light in the direction opposite to another.

OR

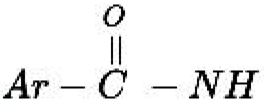
(d) Wurtz reaction

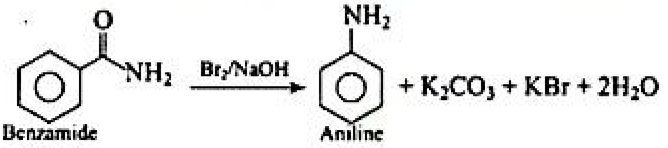
Explanation: Alkyl halides react with sodium in dry ether to give hydrocarbons containing double the number of carbon atoms present in the halide. This reaction is known as the Wurtz reaction.

$2RX + 2Na \rightarrow R\text{-}R + 2NaX$

So, $C_6H_5CH_2CH_3$ is not prepared by the Wurtz reaction.

7. (b) $ArCONH_2$

Explanation: Hofmann bromamide degradation is shown by  $Ar - \overset{O}{\overset{\|}{C}} - NH$ amide is converted into primary amine via undergoing intramolecular migration of phenyl group.



OR

(a) Primary amines

Explanation: Only primary amines undergo carbylamine reaction (isocyanide test) because only they can form isocyanide with chloroform and alc.KOH.

$RNH_2 + CHCl_3 + 3KOH \times RNC$ (foul smell) $+ 3KCl + 3H_2O$

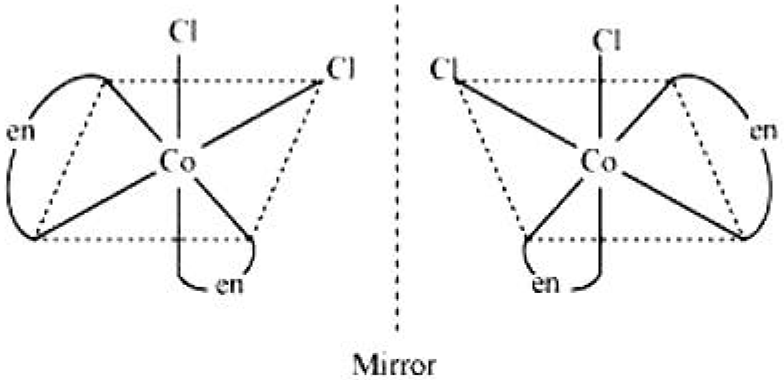
8. (b) $CrCl_3 . 6H_2O$

Explanation: $CrCl_3 .6H_2O$ can be written as $[Cr(H_2O)_6]Cl_3$. The three chloride ions are outside the square bracket means they satisfy the primary valence and hence are ionisable. Thus, it will give three chloride ions per formula unit.

OR

(c) Cis - [$Co(en)_2Cl_2]^+$

Explanation: Cis - $[Co(en)_2Cl_2]^+$ has non superimposable mirror images as shown.



Hence, it shows optical isomerism and can form d (dextrorotatory) and l (laevorotatory) isomers.

9. (b) $Mn_2(CO)_{10}$

   Explanation: CO is a neutral ligand. The overall charge on the given complex is 0. So, Mn has zero oxidation state.

10. (a) 1,2-dichloroethane

    Explanation: Dihaloalkanes having the same halogen are classified as geminal halides or gem-dihalides and vicinal halides or vic-dihalides. Gem-dihalides are molecules where halogen atoms are present on the same carbon atom where Vic-dihalides are those dihaloalkanes where the halogen atoms are present on two adjacent carbon atoms. In common naming system, the gem-dihalides are named as alkylidene halides, vic-dihalides are named as alkylene dihalides. Dichloromethane contains only one carbon, so adjacent halogen atoms cannot occur in the molecule. 1,2-dichloroethane contains two carbon atoms with adjacent halogen atoms. Ethylidene chloride, as its common name states, is a gem-dihalide. Allyl chloride contains only one chlorine atom.

11. (c) Dipole - dipole interaction

    Explanation: Polar molecule will act as a dipole.

12. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

13. (b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

14. (a) Assertion and reason both are correct statements and reason is the correct explanation for the assertion.

    Explanation: Molarity changes with temperature because volume changes with a change in temperature.

    OR

    (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

15. (b) Assertion and reason both are wrong statements.

    Explanation: Boiling points of alcohol are higher than ethers. Alcohols can form intermolecular hydrogen bonding whereas ethers cannot.

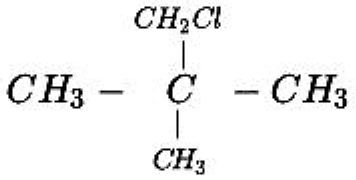
16. (d) Assertion is INCORRECT but, reason is CORRECT.

    Explanation: Assertion is INCORRECT but, reason is CORRECT.

Section B

17. i. When alkyl group is the same, the reactivity of alkyl halide is decided by the halogen present. Greater the size of a halogen atom, larger is the R-X bond length, and weaker is the bond. Thus, more reactive is alkyl halide. On going down the group size of the halides increases.
    The order of the size of halogen is
    $F < Cl < Br < I$
    Thus, the order of reactivity is $R\text{-}I > R\text{-}Br > R\text{-}Cl$

    ii. In neopentyl chloride, the leaving group is Chloride (Cl^-) ion therefore, the nucleophile will attack the C atom attached to Cl atom from the back side, according S_N^2 mechanism. As we know for S_N^2 mechanism to proceed the C atom at which the nucleophile will attach itself should be unhindered but in neopentyl this C atom is sterically hindered due to presence of three bulky $-CH_3$ groups which do not allow the nucleophile to approach the C atom to which leaving group is attached. Hence, the S_N^2 mechanism is not followed by neopentyl chloride.



$$CH_3-\underset{CH_3}{\overset{CH_2Cl}{C}}-CH_3$$

Neopentyl chloride

OR

$$\underset{1-\text{Propanol}}{CH_3CH_2CH_2\,OH}+SOCl_2\rightarrow\underset{1-Chloropropane}{CH_3CH_2CH_2Cl}+SO_2+HCl$$

18. Given, W(cane sugar) = 5 g

W(X) = 0.877 g

M(cane sugar)= 342 g mol^{-1}

π (cane sugar) = π (X) [$\because$ solution is isotonic]

$$\frac{W(\text{ cane sugar })\times 1000}{M(\text{ cane sugar })\times V}=\frac{W(X)\times 1000}{M(X)\times V}$$

$$\frac{5\ g}{342\ g\ \text{mol}^{-1}}=\frac{0.877\text{g}}{M(X)}$$

m(x) = 59.9 g mol^{-1}

19. The linkage isomer is $[Pt(ONO)(NH_3)_3]Cl$

IUPAC Name - triaminenitrito-o-platinum II chloride.

OR

The difference of energy between two sets of d-orbitals after splitting is called crystal field splitting energy or crystal field stabilizing energy (CFSE).

20. As we know for first order reaction

$$t_{1/2}=\frac{0.693}{k}$$

$$Given,\ k=200\,s^{-1}$$

$$So,\ t_{1/2}=\frac{0.693}{200}=3.47\times10^{-3}s.$$

21. It is given that T_1 = 298 K

$\therefore T_2$ = (298 + 10) K = 308 K

We also know that the rate of the reaction doubles when temperature is increased by 10°.

Therefore, let us take the value of k_1 = k and that of k_2 = 2k

Also, $R=8.314JK^{-1}mol^{-1}$

Now, substituting these values in the equation:

$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2-T_1}{T_1T_2}\right]$

We get:

$\log \frac{2k}{k} = \frac{E}{2.303\times 8.314}\left[\frac{10}{298\times 308}\right]$

$\Rightarrow \log 2 = \frac{E_a}{2.303\times 8.314}\left[\frac{10}{298\times 308}\right]$

$\Rightarrow E_a \frac{2.303\times 8.314\times 298\times 308\times \log 2}{10}$

= 52897.78 $Jmol^{-1}$

E_a = 52.9 k$Jmol^{-1}$

22. For a compound to act as an acid, it, first of all, has to loose a proton. On losing the proton, the anionic part so formed should be stable.

The more stable the anionic part will be, the more will be a tendency of the compound to loose the proton and thus more acidic will be the compound.

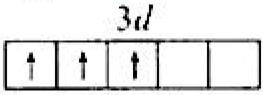
Now if there is any electron with drawing group on the benzene ring, the OH will easily loose the proton and become stable. In the case of the above-mentioned list, 2, 4, 6-trinitrophenol will be maximum acidic as on loosing the proton, there are three electron withdrawing groups that will stabilise the anionic part. Second will be nitro phenol. Although there is just one nitro group but it shows -R effect and thus stabilizes the compound after loosing the proton. The third will be 3,5 -di nitro phenol. Although in this case, the nitro group can not show resonance since it is at meta position but it will be acting as an electron withdrawing group by its inductive effect.

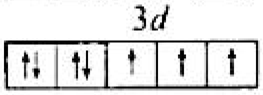
Then comes the phenol only as there is no stabilising or destabilising group. Then there is p-methyl phenol as again the negative charge will be stabilised by resonance. This will be less acidic than phenol as there is CH_3 group which is having +I effect. The last will be phenol as it will be forming just a primary carbocation with only +I stabilization.

So the order will be

2, 4, 6-trinitrophenol> 3- nitrophenol> 3,5 -di nitro phenol> phenol> 4-methyl phenol> propane-1-ol

23. The electronic configuration of Cr^{3+} and Co^{2+} ions are

$\mathrm{Cr}^{3+} = [\mathrm{Ar}]3d^3$ 

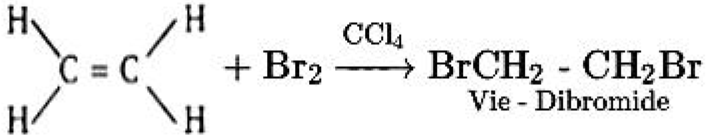
$\mathrm{Co}^{2+} = [\mathrm{Ar}]3d^7$ 

Due to symmetrical electronic configuration, there is no orbital contribution in Cr^{3+} ion.

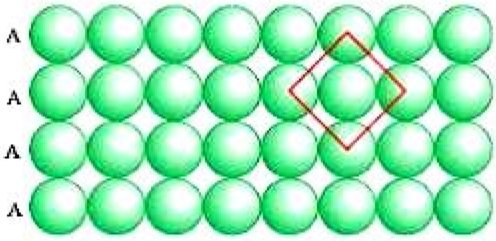
However, appreciable contribution occurs in Co^{2+} ion. Therefore, magnetic moment variation occur.

24. i. $C_6H_5N_2^+Cl^- + KI \rightarrow C_6H_5I + KCl + N_2$

ii.

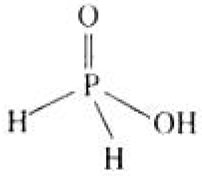


25. In the two dimensional square close packed layer, the atom touches 4 nearest neighbouring atoms. Hence, its coordination number = 4



Section C

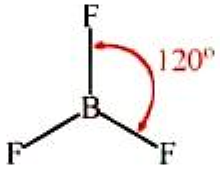
26. The phosphorus acid is a dibasic acid having an oxidation state of P = + 3 as shown below;



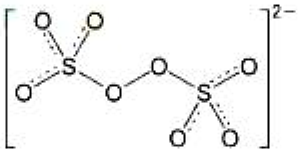
OR

Structures of compounds are given below:

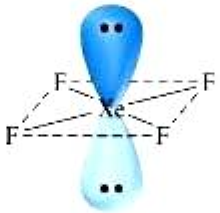
i. BF_3



ii. $S_2O_9^-$

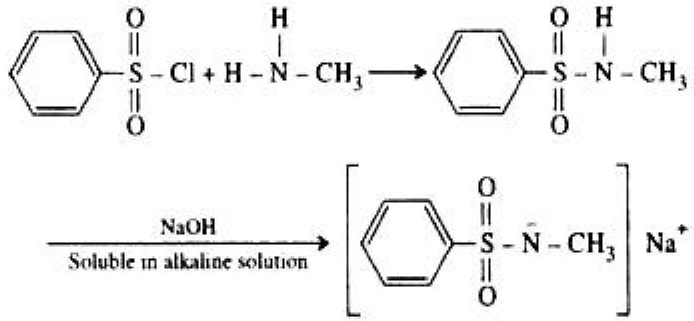


iii. XeF_4

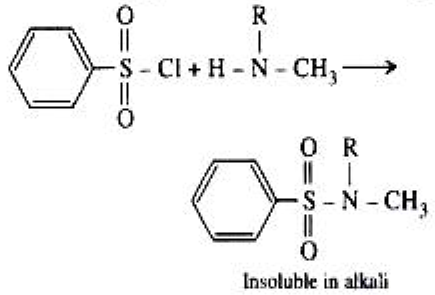


27. The Primary, secondary and tertiary amines can be distinguished by Hinsberg test. The given amine is shaken with benzene sulphonyl chloride.

   i. Primary amine forms sulphonamide which is soluble in alkali.



   ii. Secondary amine forms sulphonamide which is insoluble in alkali.



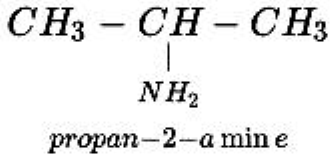
   iii. Tertiary amine will not react with Hinsberg's reagent because there is no hydrogen present on nitrogen.

OR

Following four structural isomers are possible:

1^0 Amines:

$\underset{\text{Propan}-1-amise}{CH_3CH_2CH_2NH}$

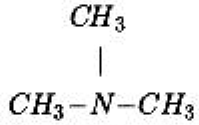


$$\underset{propan-2-a\min e}{CH_3-\underset{NH_2}{\underset{|}{CH}}-CH_3}$$

$2^0 A\min e$:

$\underset{N-Methylethana\min e}{CH_3-NH-C_2H_5}$

3^0 Amine :



$$CH_3-\underset{}{\overset{\overset{CH_3}{|}}{N}}-CH_3$$

$N.N-Dimethyimethanamine$

Only 1° amine react with HNO_2 to liberate N_2 gas.

$$\underset{\text{Propan}-1-\text{amine}}{CH_3CH_2CH_2NH_2} + HNO_2 \rightarrow \underset{\substack{\text{Propan}-1-\text{ol} \\ (\text{major product})}}{CH_3CH_2CH_2OH} + N_2 + H_2O$$

28. We know that, Atomic mass = $M = \frac{d \times a^3 \times N_A}{z}$

Where d = Density of the material = 10.5 g/cm^3

a = Length of the edge of the cell = 4.077×10^{-8} cm

N_A = Avagadro number = 6.023×10^{23} mol^{-1}

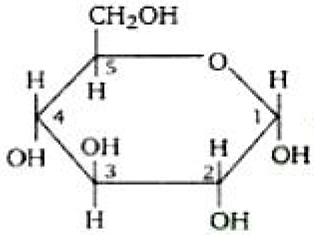
z = No. of atoms = 4

Now, put the values

$$M = \frac{10.5 g\, cm^{-3} \times (4.077 \times 10^{-8}\, cm)^3 \times (6.023 \times 10^{23} mol^{-1})}{4}$$

∴ Atomic mass of silver = 107.08g mol^{-1}

29. i. This indicates that the aldehyde group in glucose is not free.

ii. 

a - D - (+) - Glucopyranose

iii. 'D' gives the configuration, i.e. the - OH group at carbon 5 in on the right hand side + indicates that the isomer is dextrorotatory.

30. i. 2-Bromopropane to 1-bromopropane
    a. alc KOH heat
    b. HBr peroxide.

ii. Chloroethane to butane

Na wurtz reaction

iii. Benzene to diphenyl
    a. Bromine, ferric bromide
    b. Na Dry ether fitting reaction

Section D

31\. i. a. Copper (I) ions are unstable in aqueous solution and undergo disproportionation.

$2Cu^+ \longrightarrow Cu^{2+} + Cu$

The stability of Cu^{2+} (aq) rather than Cu^+ (aq) is due to the much more negative Δ_{hyd} H of Cu^{2+}(aq) than Cu^+, which compensates more for the second ionisation enthalpy of Cu.

b. Because, it has maximum number of unpaired electron.

c. Sc shows only +3 oxidation state in its salts.

${}_{21}Sc^{3+} = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^0\ 4s^0$

The ions having d^0 or d^{10} configuration are colourless or white.

ii. Preparation of $K_2Cr_2O_7$ from chromite are Chromite ore ($FeCr_2O_4$) is fused with sodium or potassium carbonate in free excess of air.

$4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow \underset{(Yellow\ solution)}{8Na_2CrO_4} + 2Fe_2O_3 + 8CO_2$ Yellow solution of sodium chromate is filtered, acidified with H_2SO_4 to obtain sodium dichromate.

$2Na_2CrO_4 + 2H^+ \longrightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$

Sodium dichromate is treated with the solution of potassium chloride.

$Na_2Cr_2O_7 + 2KCl \rightarrow \underset{(Orange\ crystals)}{K_2Cr_2O_7} + 2NaCl$

OR

On the basis of lanthanoid contraction:

i. Due to lanthanide contraction, the size of the atom decreases with the decrease in size, the covalent character increases. Therefore, La_2O_3 is more ionic while Lu_2O_3 is more covalent in nature.

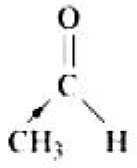
ii. As the size decreases from (lanthanum) La to (lutetium) Lu, the stability of the oxo-salts also decreases.

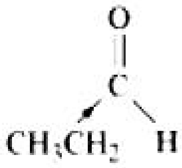
iii. Stability of complexes from La to Lu, increases as the size of the central atom decreases.

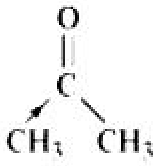
iv. Radii of the elements of 4d-and 5d-blocks in the same vertical columns are nearly the same.

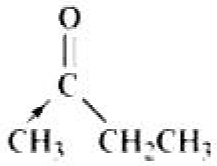
v. The acidic nature of lanthanoid oxides increases from La to Lu.

32. i.


Ethanal


Propanal


Propanone


Butanone

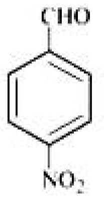
The +I effect of the alkyl group increases in the order:

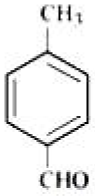
Ethanal < Propanal < Propanone < Butanone

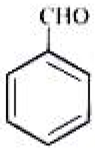
The electron density at the carbonyl carbon increases with the increase in the +I effect. As a result, the chances of attack by a nucleophile decrease. Hence, the increasing order of the reactivities of the given carbonyl compounds in nucleophilic addition reactions is:

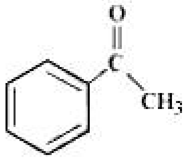
Butanone < Propanone < Propanal < Ethanal

ii.


p – Nitrobenzaldehyde


p – Tolualdehyde


Benzaldehyde


Acetophenone

The +I effect is more in ketone than in aldehyde. Hence, acetophenone is the least reactive in nucleophilic addition reactions. Among aldehydes, the +I effect is the highest in p-tolualdehyde because of the presence of the electron-donating -CH_3 group and the lowest in p-nitrobezaldehyde because of the presence of the electron-withdrawing -NO_2 group. Hence, the increasing order of the reactivities of the given compounds are:

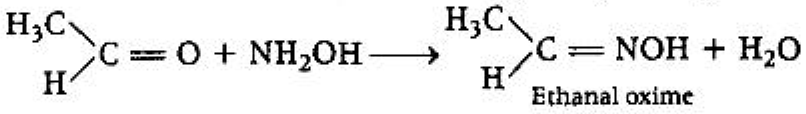
Acetophenone < p-tolualdehyde < Benzaldehyde < p-Nitrobenzaldehyde

OR

i. a. $CH_3CHO + HCN \longrightarrow CH_3CH(OH)CN$

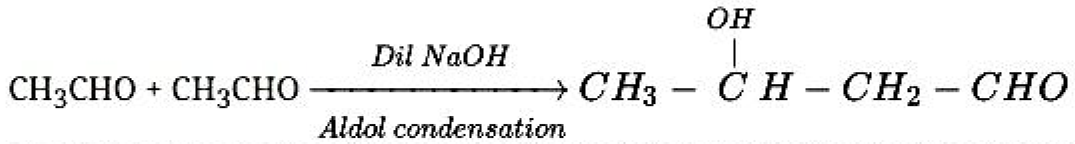
Acetaldehyde cyanohydrin

b.



$$H_3C(H)C{=}O + NH_2OH \longrightarrow H_3C(H)C{=}NOH + H_2O$$

Ethanal oxime

c. 

$$CH_3CHO + CH_3CHO \xrightarrow[\text{Aldol condensation}]{\text{Dil NaOH}} CH_3 - \overset{\overset{OH}{|}}{C}H - CH_2 - CHO$$

ii. a. Phenol and benzoic acid can be distinguished by the ferric chloride test. Phenol reacts with neutral $FeCl_3$ to form ferric phenoxide complex giving violet colouration.

$$\underset{\text{Phenol}}{6C_6H_5OH} + FeCl_3 \longrightarrow \underset{\substack{\text{Iron-phenol complex}\\ \text{(Violet colour)}}}{[Fe(OC_6H_5)_6]^{3-}} + 6H^+ + 3Cl^-$$

But benzoic acid reacts with neutral $FeCl_3$ to give a buff coloured precipitate of ferric benzoate.

$$\underset{\text{Benzoic acid}}{3C_6H_5COOH} + FeCl_3 \longrightarrow \underset{\substack{\text{Ferric benzoate}\\ \text{(Buff coloured ppt.)}}}{(C_6H_5COO)_3Fe} + 3HCl$$

b. **Propanal and propanone:**

These compounds can be distinguished by using Tollen's test. Propanal being an aldehyde reduces Tollen's reagent to shining silver mirror and propanone being a ketone does not.

$$\underset{\text{Propanal}}{CH_3CH_2CHO} + \underset{\text{Tollen's reagent}}{2[Ag(NH_3)_2]^+} + 3OH^- \longrightarrow$$

$$\underset{\text{Propanoate ion}}{CH_3CH_2COO^-} + \underset{\text{Silver mirror}}{2Ag\downarrow} + 4NH_3 + 2H_2O$$

$$\underset{\text{Propanone}}{CH_3COCH_3} \xrightarrow[\text{reagent}]{\text{Tollen's}} \text{No silver mirror}$$

33. Both conductivity and molar conductivity change with the concentration of the electrolyte. Conductivity always decreases with decrease in concentration both, for weak and strong electrolytes. This can be explained by the fact that the number of ions per unit volume that carry the current in a solution decreases on dilution. The conductivity of a solution at any given concentration is the conductance of one unit volume of solution kept between two platinum electrodes with unit area of cross section and at a distance of unit length.

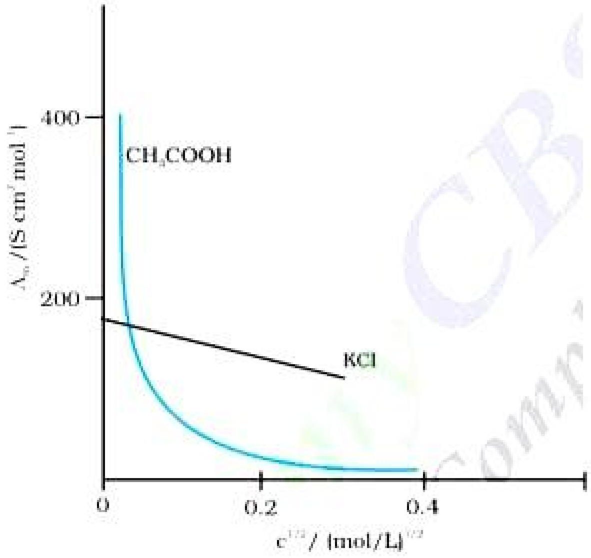
This is clear from the equation:

$G = \frac{\kappa A}{l} = \kappa$ (both A and l are unity in their appropriate units in m or cm)

Molar conductivity of a solution at a given concentration is the conductance of the volume V of solution containing one mole of electrolyte kept between two electrodes with area of cross section A and distance of unit length. Since l = 1 and A = V (Volume containing 1 mole of electrolyte). Therefore,

$$\Lambda_m = \frac{\kappa A}{l} = \kappa V$$

Molar conductivity increases with decrease in concentration. This is because the total volume, V, of solution containing one mole of electrolyte also increases. It has been found that decrease in κ on dilution of a solution is more than compensated by increase in its volume. Physically, it means that at a given concentration, Λ_m can be defined as the conductance of the electrolytic solution kept between the electrodes of a conductivity cell at unit distance but having area of cross section large enough to accommodate sufficient volume of solution that contains one mole of the electrolyte. When concentration approaches zero, the molar conductivity is known as limiting molar conductivity and is represented by the symbol Λ_m° . The variation in Λ_m with concentration is different for strong and weak electrolytes as shown in the figure.



Molar conductivity versus c½ for acetic acid (weak electrolyte) and potassium chloride (strong electrolyte) in aqueous solutions.

For strong electrolytes, Λ_m increases slowly with dilution and can be represented by the equation:

$$\Lambda_m = \Lambda_m^\circ - Ac^{1/2}$$

Weak electrolytes like acetic acid have lower degree of dissociation at higher concentrations and hence for such electrolytes, the change in Λ_m with dilution is due to increase in the degree of dissociation and consequently the number of ions in total volume of solution that contains 1 mol of electrolyte. In such cases Λ_m increases steeply on dilution, especially near lower concentrations as shown in the given figure above.

OR

a. Weak Electrolysis: Those electrolysis which do not dissociate into ions completely in aqueous solution, e.g. CH_3COOH

Strong electrolytes: Strong electrolytes are those which dissociate into ions completely in aqueous solution e.g.KCl

b. $Fe(s) + 2H^{+}(aq) \rightarrow Fe^{2+}(aq) + H_2(g)$

$$E_{cell} = \left[E^0(H^+/H_2) - E^0(Fe^{2+}/Fe)\right] - \frac{0.0591}{2}\log\frac{[Fe^{2+}]}{[H^+]^2}$$

$$= [0 - (0.44)] - \frac{0.0591}{2}\log\frac{0.001}{1^2}$$

$$= +0.44V + \frac{0.1773}{2}$$

= 0.44 V + 0.0886 V

= 0.5286 V