CBSE Class 12 - Chemistry
Sample Paper 08 (2020-21)

Maximum Marks: 70
Time Allowed: 3 hours

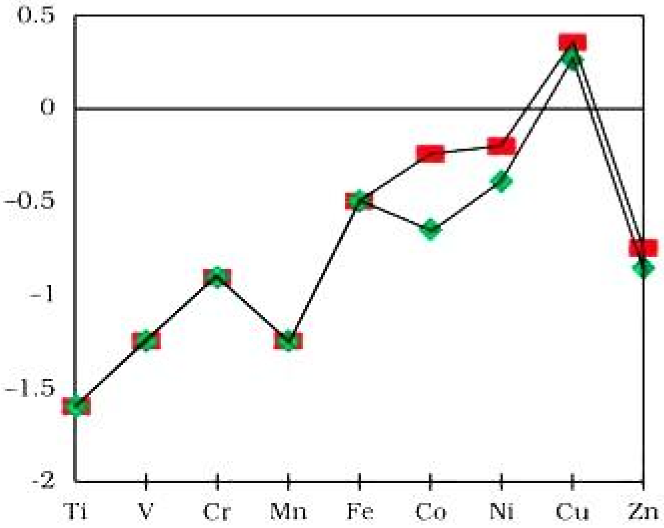
General Instructions:

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:**

The unique behaviour of Cu, having a positive E° accounts for its inability to liberate H_2 from acids. Only oxidising acids (nitric and hot concentrated sulphuric) react with Cu, the acids being reduced. The stability of the half-filled d sub-shell in Mn^{2+} and the completely filled d^{10} configuration in Zn^{2+} are related to their E° values, whereas E° for Ni is related to the highest negative $\Delta_{hyd}H°$. An examination of the E° (M^{3+}/M^{2+}) values the low value for Sc reflects the stability of Sc^{3+} which has a noble gas configuration. The comparatively high value for Mn shows that $Mn^{2+}(d^5)$ is particularly stable, whereas a comparatively low value for Fe shows the extra stability of Fe^{3+} (d^5). The comparatively low value for V is related to the stability of V^{2+} (half-filled t_{2g} level).



The following questions are multiple-choice questions. Choose the most appropriate answer.

i. Ionisation enthalpy along with each series of the transition elements from left to right
   a. increase
   b. decrease
   c. remain the same
   d. none of these

ii. The stability of Cu^{2+} (aq) rather than Cu^{+}(aq) is due to
   a. more negative $\Delta_{hyd}H^{\circ}$ of Cu^{2+} (aq)
   b. less negative $\Delta_{hyd}H^{\circ}$ of Cu^{2+} (aq)
   c. more positive $\Delta_{hyd}H^{\circ}$ of Cu^{2+} (aq)
   d. less positive $\Delta_{hyd}H^{\circ}$ of Cu^{2+} (aq)

iii. Why is Cr^{2+} reducing and Mn^{3+} oxidising?
   a. Cr^{2+} is reducing as its configuration changes from d^4 to d^3
   b. the latter having a half-filled t_{2g} level
   c. the change from Mn^{3+} to Mn^{2+} results in the half-filled (d^5) configuration
   d. all of these

iv. Zn has high value for M^{3+}/M^{2+} Standard Electrode Potentials
   a. due to large size
   b. due to the removal of an electron from the stable d^{10} configuration of Zn^{2+}.
   c. both (a) and (b)

   d. none of these

v. Transition metals, despite high E° oxidation, are poor reducing agents. The incorrect reason is
   a. high heat of vaporization
   b. high ionization energies
   c. low heats of hydration
   d. complex forming nature

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

Isomers are two or more compounds that have the same chemical formula but a different arrangement of atoms. Due to the different arrangements of atoms, they differ in one or more physical or chemical properties. Two principal types of isomerism are known among coordination compounds. Stereoisomerism includes geometrical isomerism, optical isomerism while Structural isomerism consists of linkage isomerism, coordination isomerism, Ionisation isomerism and Solvate isomerism. Isomerism arises in heteroleptic complexes due to different possible geometric arrangements of the ligands. In a square planar complex of formula $[MX_2L_2]$ X and L are unidentate, the two ligands X may be arranged adjacent to each other in a cis isomer, or opposite to each other in a trans isomer. Solvate form of isomerism is known as 'hydrate isomerism' in the case where water is involved as a solvent. This is similar to ionisation isomerism.

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 but reason is wrong statement.
d. Assertion is wrong statement but reason is correct statement.

i. **Assertion:** Optical isomers are mirror images that cannot be superimposed on one another.

   Reason: The molecules or ions that cannot be superimposed are called chiral.

ii. **Assertion:** $[Cr(H_2O)_6]Cl_3$ is an aqua complex and its solvate isomer is

$[Cr(H_2O)_5Cl]Cl_2.H_2O$.

Reason: Solvate isomer is also known as linkage isomers.

iii. **Assertion:** Thiocyanate is an ambidentate ligand.

Reason: Thiocyanate ligand, NCS^- is present which can bind through the nitrogen to give M–NCS or through sulphur to give M–SCN.

iv. **Assertion:** $[Co(NH_3)_5SO_4]Br$ and $[Co(NH_3)_5Br]SO_4$ are coordination isomer.

Reason: Ionisation isomers are formed when the counter ion in a complex salt is itself a potential ligand and can displace a ligand which can then become the counter ion.

v. **Assertion:** Square planar complex shows three isomers-two cis and one trans.

Reason: Stereoisomers have the same chemical formula and chemical bonds but they have different spatial arrangements.

3. Aniline upon heating with conc. HNO_3 and conc. H_2SO_4 mixture gives:
   a. The mixture of o, p, and m nitroaniline:
   b. No reaction
   c. o-and p-nitroaniline
   d. o-nitroaniline
4. Peptide linkage is present in:
   a. Carbohydrates
   b. Proteins
   c. Vitamins
   d. Rubber

OR

Commercially glucose is obtained by

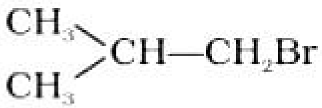
a. hydrolysis of sucrose
b. boiling sucrose with dilute HCl or H_2SO_4 in alcoholic solution
c. hydrolysis of starch by boiling it with dilute H_2SO_4 at 393 K under pressure.
d. crushing ripe grapes

5. Which of the following has highest boiling point?
   a. 0.1 molal urea solution
   b. 0.1 molal NaCl solution

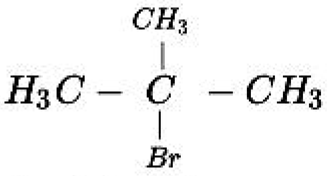
c. 0.1 molal $BaCl_2$ solution

d. 0.1 molal sugar solution

6. Arrange the following compounds in increasing order of their boiling points.

a. 

b. $CH_3CH_2CH_2CH_2Br$

c. 

$$H_3C - \overset{CH_3}{\underset{Br}{C}} - CH_3$$

a. (c) < (a) < (b)

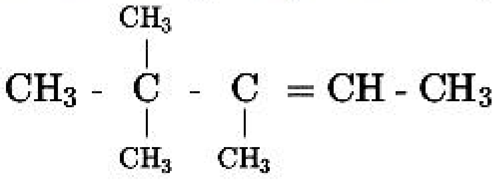
b. (c) < (b) < (a)

c. (a) < (b) < (c)

d. (b) < (a) < (c)

OR

The following compound is ,as per the IUPAC system



$$CH_3 - \overset{CH_3}{\underset{CH_3}{C}} - \underset{CH_3}{C} = CH - CH_3$$

a. 3, 4, 4 - triethyl pent - 2 - ene

b. 2 diethyl, 3 - ethyl pentene

c. None of these

d. 2, 2, 3 - triethyl pent - 4 - ene

7. Secondary amines react with the nitrosonium ion to generate:

a. N – nitrosoamines

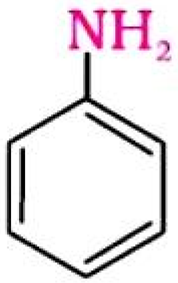
b. anilines

c. imines

d. oximes

OR

The following amine is called as



- a. Nitrobenzene
- b. Aniline and phenylamine
- c. Aniline and o-toluidine
- d. O - Toluidine

8. Which among the following is adsorbed greatly by activated charcoal?
   - a. H_2
   - b. CH_4
   - c. CO
   - d. SO_2

OR

At high concentration of soap in water, soap behaves as _______.

- a. macromolecular colloid
- b. molecular colloid
- c. associated colloid
- d. lyophilic colloid

9. Rate of physisorption increases with:
   - a. decrease in pressure
   - b. increase in temperature
   - c. decrease in surface area
   - d. decrease in temperature
10. In the reaction, $R - X + NaOR' \rightarrow ROR' + X$ (– ve ion). The main product formed is:
    - a. Ether
    - b. Alcohol
    - c. Ester
    - d. Amine

11. In cubic close packing(ccp) arrangement, the pattern of the successive layers will be designated as
    a. ABC, ABC, ABC
    b. AB, ABC, AB, ABC....
    c. None of these
    d. AB, AB, AB....
12. **Assertion:** NF_3 is weaker ligand than $N(CH_3)_3$.

    Reason: NF_3 ionises to give F^- ions in aqueous solution.
    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:** When NaCl is added to water a depression in freezing point is observed.
    Reason: The lowering of the vapour pressure of a solution causes depression in the freezing point.
    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. The assertion is a correct statement but the reason is the wrong statement.
    d. Assertion and reason both are incorrect statements.

OR

Assertion: A solution having greater vapour pressure has a higher boiling point.

Reason: Elevation in boiling point is directly proportional to the lowering of vapour pressure.

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:** Glycerol does not react with HI.

    Reason: 2 - Iodopropane can be produced by treatment of glycerol with HI.

    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.

16. **Assertion:** In monohaloarenes, further electrophilic substitution occurs at ortho and para positions.

    Reason: Halogen atom is a ring deactivator.

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

Section B

17. Why are haloarenes more stable than haloalkanes and undergo electrophilic substitution reaction at ortho and para positions?

OR

p - dichlorobenzene has higher melting point than meta - dichlorobenzene because

18. Define molal elevation constant or ebullioscopic constant.
19. What causes Brownian movement in a colloidal solution?

OR

Explain the following:

a. Same substance can act as both as colloids and crystalloids.
b. Artificial rain is caused by spraying salt over clouds.
c. When a beam of light is passed through a colloidal sol, the path of the beam gets illuminated.

20. Three-fourth of a reaction is completed in 32 minutes. What is the half life period of this reaction?
21. Distinguish between rate expression and rate constant of a reaction.
22. Explain why low molecular mass alcohols are soluble in water.
23. Why is the third ionization energy of manganese (Atomic Number = 25) unexpected high?
24. Convert:1- chloropropane to 2- iodopropane.
25. What is meant by co-ordination number in an ionic crystal?

Section C

26. How are the following compounds prepared from XeF_6?

i. $XeOF_4$
ii. XeO_3

OR

Give reasons:

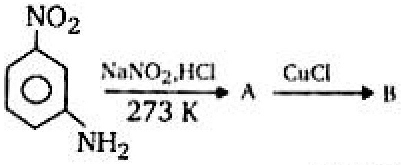
i. SO_2 is reducing while TeO_2 is an oxidising agent.
ii. Nitrogen does not form pentahalides.
iii. ICl is more reactive than I_2.

27. Identify the compounds A, B and C in the following compounds:

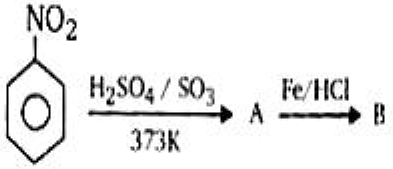
$$(A) \xrightarrow{Br_2/KOH} (B) \xrightarrow[HNO_2]{NaNO_2/HCl} (C) \xrightarrow[Br_2]{Red\ P/} CH_3Br$$

OR

Identify A and B in the following reactions:

i. 

ii. $CH_3CH_2CH_2Br \xrightarrow{NaGN} A \xrightarrow{LiAJH_i} B$

iii. 

28. Copper crystallizes into a fcc lattice with edge length $3.6 \times 10^{-8} cm$. Show that the calculated density is in agreement with its measured value of 8.92 g cm^{-3}.
29. Which sugar is called invert sugar? Why is it called so?
30. How can phenol be converted to aspirin?

Section D

31. Explain each of the following:
    - i. Nitrogen is much less reactive than phosphorus.
    - ii. The stability of +5 oxidation state decreases down the group 15.
    - iii. The bond angles (O-N-O) are not of the same value in NO_2^- and NO_2^+.

OR

a. i. Which allotrope of phosphorus is more reactive and why?
   ii. How the supersonic jet aeroplanes are responsible for the depletion of ozone layers?
   iii. F_2 has lower bond dissociation enthalpy than Cl_2. why?

b. i. Which noble gas is used in filling balloons for meteorological observations?
   ii. Complete the equation: $\mathrm{XeF_2 + PF_5}$

32. Give simple chemical tests to distinguish between the following pairs of compounds:
    - i. Ethanal and propanal.
    - ii. Benzoic acid and phenol.

OR

Write the structures of the following compounds.

i. 2-Methoxypropionaldehyde
ii. 3-Hydroxybutanal
iii. 2-Hydroxycyclopentanecarbaldehyde
iv. 4-Oxopentanal
v. Di-sec-butyl ketone

33. a. Explain why electrolysis of aqueous solution of NaCl gives H_2 at cathode and Cl_2 at anode. Write overall reaction.

$$E^0{}_{(Na^+/Na)} = -2.71V; E^0{}_{(H_2O/H_2)} = -0.83V$$
$$E^0{}_{(Cl_2/2Cl^-)} = 1.36V; E^0(H^+, O_3/H_2O) = 1.23V$$

b. Calculate the emf of the cell Zn | Zn^{2+}(0.1 M) || Cd^{2+} (0.01 M) | Cd at 298 K

$$Given\, E^0{}_{(Zn^{2+}/Zn)} = -0.75V; E^0{}_{(Cd^+/Cd)} = -0.40V$$

OR

1. Account for the following:
   i. Alkaline medium inhibits the rusting of iron.
   ii. Iron does not react even if the zinc coating is broken in a galvanized iron pipe.
2. Construct the galvanic cell using the following data:-

$$Ag^{2+} + e^- \rightarrow Ag \quad E^0 = +0.80V$$
$$Cu^{2+} + 2e^- \rightarrow Cu \quad E^0 = +0.34V$$

For what concentration Ag^+ ions will the emf of the cell be zero at 25°C if the concentration of Cu^{2+} is 0.01 M? [log 3.919 = 0.593]

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Solution

Section A

1. i. (a) increase
   ii. (a) more negative $\Delta_{hyd} H^\circ$ of Cu^{2+} (aq)
   iii. (d) all of these
   iv. (b) due to the removal of an electron from the stable d^{10} configuration of Zn^{2+}
   v. (d) complex forming nature
2. i. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
   ii. (c) Assertion is correct statement but reason is wrong 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. (a) The mixture of o, p, and m nitroaniline:

   Explanation: Mixture of ortho, meta, and para nitroaniline is formed because of the formation of anilinium ion which is formed by direct nitration of aniline.
4. (b) Proteins

   Explanation: Peptide linkage is present in proteins. It is a chemical bond formed between two molecules when the carboxyl group of one molecule reacts with the amino group of other molecules, releasing a molecule of water.

   OR

   (c) hydrolysis of starch by boiling it with dilute H_2SO_4 at 393 K under pressure.

   Explanation: Commercially glucose is obtained by hydrolysis of starch by boiling it with dilute H_2SO_4 at 393 K under pressure (2-3 atm).

$$(C_6H_{10}O_5)_n + nH_2O \rightarrow nC_6H_{12}O_6$$

5. (c) 0.1 molal $BaCl_2$ solution

   Explanation: i=3 so ΔT_b will be maximum and hence Tb will be maximum.
6. (a) (c) < (a) < (b)

   Explanation: The bolling points of isomeric haloalkanes decrease with an increase in branching as with an increase in branching surface area decreases which leads to a decrease in intermolecular forces. Hence, the increasing order of their boiling points is c < a < b.

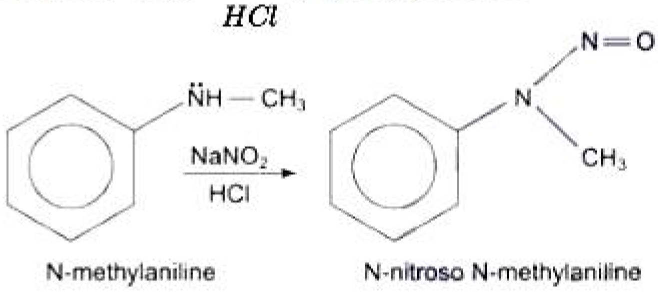
   OR

   (a) 3, 4, 4 - triethyl pent - 2 - ene

   Explanation: Longest chain contains double bond.
7. (a) N – nitrosoamines

   Explanation: Secondary amines react with nitrosonium ion to form N-nitrosoamine.

   $$CH_3\text{-}NH\text{-}CH_3 \xrightarrow[HCl]{NaNO_2} (CH_3)_2\text{-}N\text{-}N{=}O$$

   OR

   (b) Aniline and phenylamine

   Explanation: $C_6H_5NH_2$ is known as aniline. Here, the amino group is directly attached to phenyl ring so it is also known as phenylamine. This is an aromatic primary amine.
8. (d) SO_2

   Explanation: SO_2 due to high polarity and surface area is adsorbed maximum.

   OR

   (c) associated colloid

   Explanation: At low concentration, the soap solution behaves like a normal strong electrolyte. But at high concentration, soap molecules aggregate to form micelles. These are known as associated colloids.

9. (d) decrease in temperature

   Explanation: decrease in temperature

10. (a) Ether

    Explanation: The given reaction is an example of the substitution reaction.

11. (a) ABC, ABC, ABC

    Explanation: First layer and fourth layer are same.

12. (c) Assertion is CORRECT but, reason is INCORRECT.

    Explanation: Assertion is CORRECT but, reason is INCORRECT.

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: When a non-volatile solute is added to water, freezing point lowers due to lowering of vapor pressure.

    OR

    (d) Assertion is INCORRECT but, reason is CORRECT

    Explanation: Assertion is INCORRECT but, reason is CORRECT

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

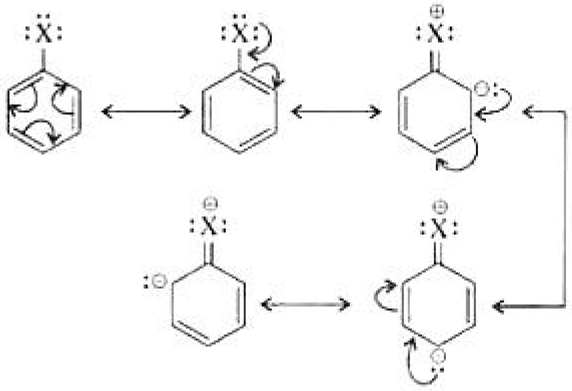
    Explanation: Assertion is INCORRECT but, reason is CORRECT.

16. (a) Assertion and reason both are correct statements but the reason is not the correct explanation of assertion.

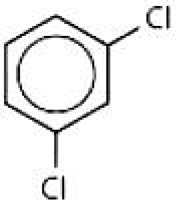
    Explanation: Further electrophilic substitution occurs at ortho and para positions because halogen atoms are ortho and para directing, not because they are ring deactivators.

Section B

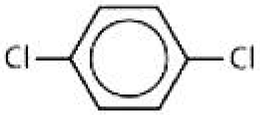
17. Haloarenes are resonance hybrid of following five structures. The electron density gets concentrated more at ortho and para positions. Thus they are stable and undergo electrophilic substitution at ortho and para positions.



OR



1,3-dichlorobenzene
m-dichlorobenzene



1,4-dichlorobenzene
p-dichlorobenzene

p- dichlorebenzene have symmetrical structure therefore it can fit better into the crystal lattice which increases its melting point.

18. Molal elevation constant is defined as increase in boiling point of the solvent, when one mole of solute is dissolved in 1000g of solvent. The elevation is proportional to the number of particles dissolved and given by $\Delta T_b = K_b$ m, where m is the molal concentration of solute. The constant K_b is the ebullioscopic constant of the solvent.
19. The Brownian movement arises due to the unbalanced bombardment of particles by the molecules of the dispersion medium. The Brownian movement has a stirring effect which does not permit the particles to settle and thus, is responsible for stability of sols.

OR

a. The same substance can act as both colloid and crystalloid. It depends on the size of the particles, when the size of the particles likes between 1 to 1000 nm, it behaves as a colloid. If particles size is less than 1 nm, it exists as a true solution and behaves like a crystalloid.
b. Artificial rain is caused by spraying salt over clouds. The colloidal water particles of the clouds get neutralized by oppositely charged ions of the salt and coagulated to

bigger water drop cause artificial rain.

c. When a beam of light is passed through a colloidal solution, the path of beam gets illuminated with visible light. This is due to scattering of light by colloidal particles.

20. Step. 1. Calculation of the rate constant (k) for the reaction

$k = \frac{2.303}{t} \frac{loga}{a-x}$

a=100, x=75, (a-x) = 100-75, t=32 minutes

$k = \frac{2.303}{32min} \frac{log100}{25} = \frac{2.303}{32min} log4 = \frac{2.303 \times 0.6021}{32min}$

$= 0.0433 min^{-1}$

Step II) Calculation of the half-life period ($t_{1/2}$)

$t_1/2 = \frac{0.693}{k} = \frac{0.693}{0.0433 min^{-1}} = 16 min$

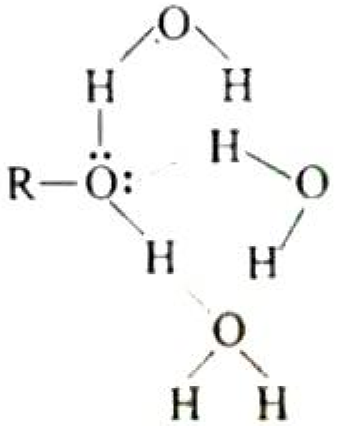
21. Rate expression is the way to express rate of reaction in terms of concentration of reactants.

For a chemical reaction $aA + bB \rightarrow cC + dD$

$Rate = k[A]^x[B]^y$

Rate constant (k) is defined as the rate of reaction when the concentration of reactants are taken unity.

22. The lower members of alcohol are highly soluble in water but the solubility decreases with an increase in molecular weight. The solubility of lower alcohols in water is due to hydrogen bonds between alcohols and water molecules.



23. Mn (25) has electronic configuration = [Ar] $3d^5 4s^2$

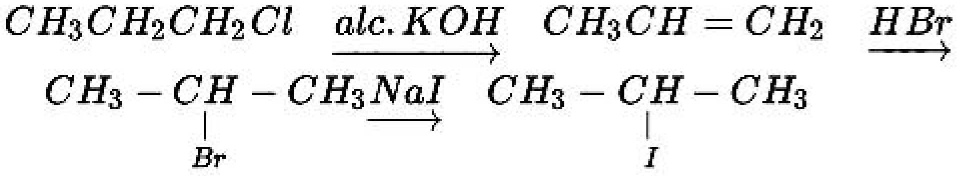
Mn^{2+} has electronic configuration = [Ar] $3d^5 4s^0$

After losing 2 electrons, it has half filled d-orbital, which is more stable that is why Mn^{2+} has exceptionally high third ionization energy.

24. Step 1: Treat chloropropane with alc. KOH to give propene

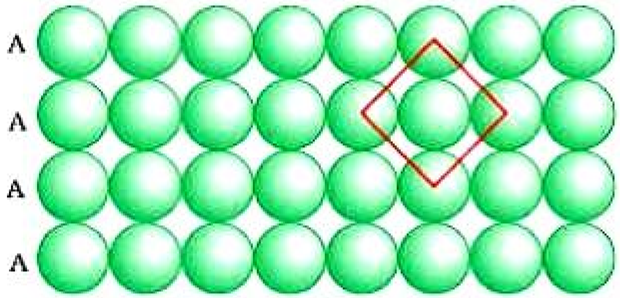
Step 2: Treat propene with HBr to give 2-bromopropane

Step 3: Treat 2-bromopropane with NaI to give 2-iodopropane



$$CH_3CH_2CH_2Cl \xrightarrow{alc. KOH} CH_3CH=CH_2 \xrightarrow{HBr} CH_3-\underset{Br}{\underset{|}{CH}}-CH_3 \xrightarrow{NaI} CH_3-\underset{I}{\underset{|}{CH}}-CH_3$$

25. **Coordination number:** The number of closest neighbours of any constituent particle is called its coordination number. e.g. Co-ordination number in square close packing is 4.



Section C

26. Hydrolysis of XeF_6 with water gives $XeOF_4$ and XeO_3
    i. Partial hydrolysis of XeF_6 gives $XeOF_4$: $XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$
    ii. Complete hydrolysis of XeF_6 gives XeO_3 : $XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

OR

i. The dioxide molecules contain pπ–pπ bonds which become weaker with increase in atomic number because, increase in atomic no. increases size along a group and hence there occurs an increase in the bond length and so the reducing character decreases down the group. Due to presence of d-orbitals (vacant), sulphur can extend its covalency and show oxidation states till +6, which is stable in sulphur (eg: SF_6).

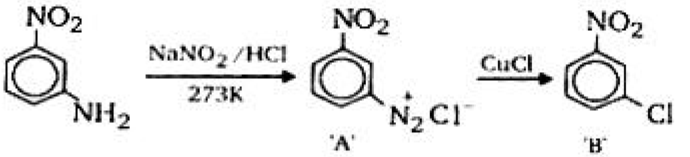
   Hence it acts as a reducing agent, and now the character decreases down the group because of decrease in strength of the pπ–pπ bonds while, unlike sulphur, Te cannot show +6 oxidation state as it is highly unstable due to inert pair effect. Therefore there can only be a decrease in its oxidation state (it can decrease to -2, +2 etc). Hence, TeO_2 acts as oxidizing agent.

ii. Nitrogen does not form pentahalide due to the absence of d-orbitals. While all the elements of its group have vacant d-orbitals that helps them in making pentahalides such as PCl_5.

iii. Interhalogen compounds are more reactive than halogens (except fluorine) because X-X' bond (I-Cl bond in halogens) in interhalogen compounds is weaker than X-X bond (I- I bond) in halogens due to their polar nature.

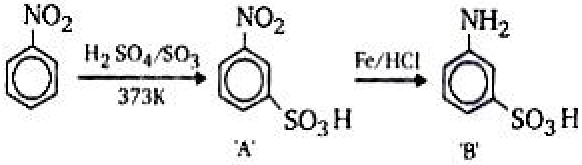
27. $\underset{(A)}{CH_3CONH_2} \xrightarrow{Br_2/KOH} \underset{(B)}{CH_3NH_2} \xrightarrow[HNO_2]{NaNO_2/HCl} \underset{(C)}{CH_3OH} \xrightarrow[Br_2]{\text{Red } P/} CH_3Br$

OR

i. 

3-Chloronitrobenzene

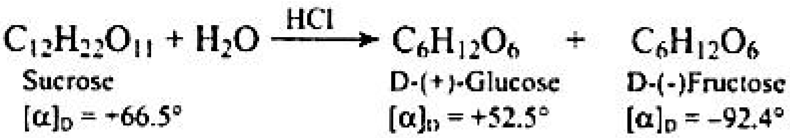
ii. $CH_3CH_2CH_2Br \xrightarrow{NaGN} \underset{'A'}{CH_3CH_2\,CH_2\,C}$
$\equiv N = \xrightarrow{LiAJH_4} \underset{\underset{'B'}{Bu\tan a\min e}}{CH_3CH_2CH_2CH_2NH_2}$

iii. 

28. We know that,
$d = \frac{z \times M}{a^3 \times N_A}$
No. of atoms in fcc lattice, z = 4
$= \frac{4 \times 63.5 mol^{-1}}{(3.61 \times 10^{-8} cm)^3 \times (6.02 \times 10^{23} mol^{-1})}$
Atomic mass of unit cell $= \frac{4 \times 63.5}{6.02 \times 10^{23}} = 4.22 \times 10^{-22} g$
Now, Density $= \frac{\text{Mass of unit cell}}{\text{Vol. of unit cell}}$
$= \frac{4.22 \times 10^{-22}}{47.4 \times 10^{-24} cm^2} = 8.9 g\, cm^{-3}$
which is in close agreement with the measured value.

29. Sucrose is called invert sugar. The sugar obtained from sugar beet is a colourless, crystalline and sweet substance. It is very soluble in water and its aqueous solution is dextrorotatory having $[\alpha]_D = +66.5^\circ$. On hydrolysis with dilute acids or enzyme invertase, cane

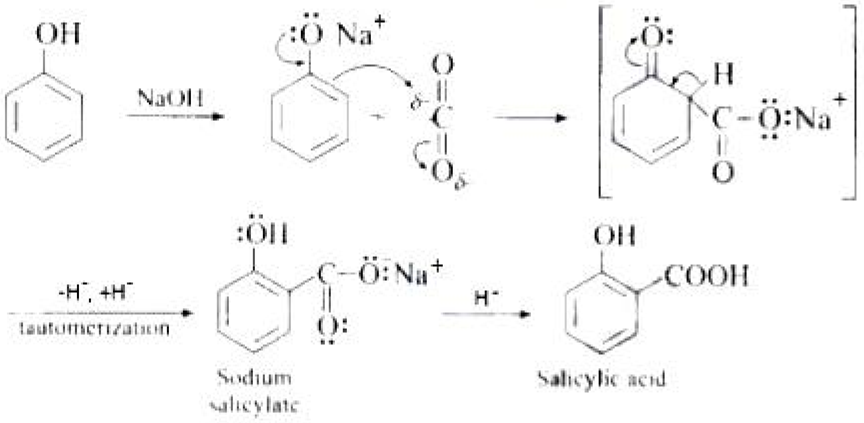
sugar gives an equimolar mixture of D - (+)-glucose and D-(-)-fructose.



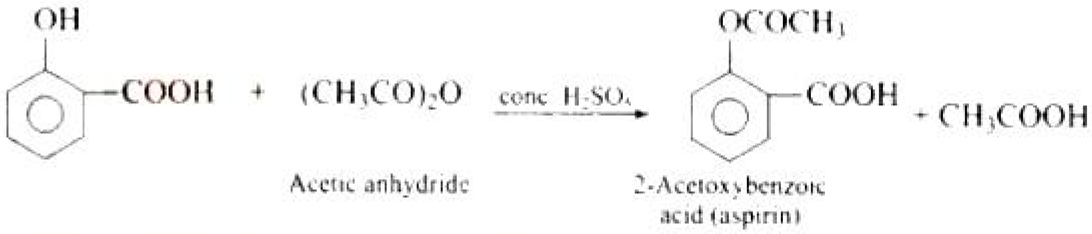
$$\underset{\substack{\text{Sucrose}\\ [\alpha]_D = +66.5^\circ}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{HCl} \underset{\substack{\text{D-(+)-Glucose}\\ [\alpha]_D = +52.5^\circ}}{C_6H_{12}O_6} + \underset{\substack{\text{D-(-)Fructose}\\ [\alpha]_D = -92.4^\circ}}{C_6H_{12}O_6}$$

So, sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose. D-(-)-fructose has a greater specific rotation than D-(+)-glucose. Therefore, the resultant solution upon hydrolysis is laevorotatory in nature. Since the laevorotation of fructose (–92.4°) is more than dextrorotation of glucose (+ 52.5°). Thus, hydrolysis brings change in the sign of rotation from dextro before hydrolysis to laevo after hydrolysis, the reaction is called inversion reaction and the mixture (glucose and fructose) is called invert sugar.

30. Phenol is converted into salicylic acid. The reaction is usually carried out by allowing sodium phenoxide to absorb carbon dioxide and then heating the product to 400 K and 4-7 atm pressure. The first unstable intermediate is formed which undergoes a proton shift to form sodium salicylate. The subsequent acidification of sodium salicylate gives.



Then aspirin is obtained by acetylating salicylic acid with acetic anhydride and conc. H_2SO_4



The preparation of Aspirin from salicylic acid is an example of an electrophilic substitution reaction in which carbon dioxide is an electrophile.

Section D

31. i. Nitrogen is chemically less reactive. This is due to the presence of a more stable triple bond in N_2 molecule (high bond enthalpy of $N \equiv N$ bond).

Whereas, phosphorus forms only P-P single bond. Therefore, phosphorus is more reactive than nitrogen.

ii. Due to inert pair effect, nuclear attraction increases on s-electrons as a result they does not participate. The lower oxidation state (+3) gets stable whereas, the higher oxidation state gets unstable down the group. Hence, the stability of +5 oxidation state decreases down the group.

iii. The difference in bond angle is due to the fact that NO_2^+ does not have lone pair of electrons on N-atom but NO_2^- has a lone pair of electrons on the N-atom.

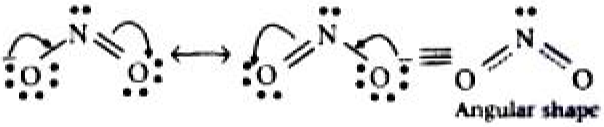
Structure of NO_2^+

$:\ddot{O} = \overset{+}{N} = \ddot{O}:$

NO_2^+ = Linear shape

Bond angle = 180°

Structure of NO_2^-



Bond angle = 120°

OR

a. i. White phosphorus because it is monomeric and has low bond dissociation enthalpy due to angle of strain (bond angle of strain (bond angle 60$^{\text{o}}$).

ii. Supersonic jet aeroplanes release NO which is responsible for the depletion of ozone layer. $\mathrm{NO} + \mathrm{O_3} \rightarrow \mathrm{NO_2} + \mathrm{O_2}$

iii. it is due to more interelectronic repulsion between lone pair of electrons.

b. i. Helium.

ii. $\mathrm{XeF_2} + \mathrm{PF_5} \rightarrow [\mathrm{XeF}] + [\mathrm{PF}]-$

32. i. **Distinguishing test between ethanal and propanal**

Iodoform test Ethanal because of the presence ofCH3CO- skeleton gives positive iodoform test whereas propanal due to the absence of such a skeleton does not gives such test.

$$\underset{\text{Acetaldehyde}}{\underset{\text{Or}}{\underset{\text{Ethanal}}{CH_3CHO}}} + 4NaOH + 3I_2 \longrightarrow \underset{\text{Iodoform}}{\underset{\text{(Yellow ppt)}}{CHI_3}} + \underset{\text{Sodium formate}}{HCO\overline{N}^{+}a} + \underset{\text{iodade}}{\underset{\text{Sodium}}{3NaI}} + 3H_2O$$

$$\underset{\text{Propanal}}{CH_3CH_2CHO} + 4NaOH + 3I_2 \longrightarrow \text{No reaction}$$

ii. **Distinguishing test between benzoic acid and phenol**

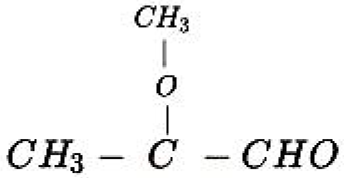
Phenol and benzoic acid can be distinguished by ferric chloride test. Phenol reacts with neutral $FeCl_3$ to form ferric phenoxide complex giving violet colouration.

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

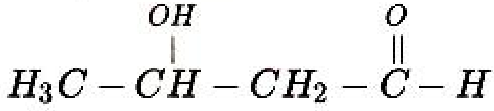
But benzoic acid reacts with neutral $FeCl_3$ to give a buff coloured precipitate of ferric benzoate.

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

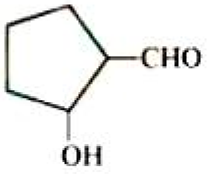
OR

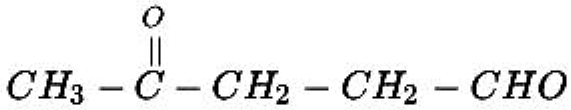
i. 

$$CH_3 - \overset{\overset{CH_3}{|}}{\overset{O}{\overset{|}{C}}} - CHO$$

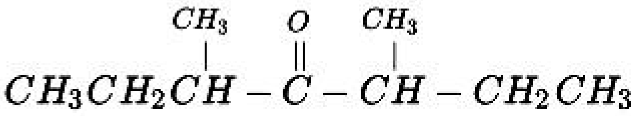
ii. 

$$H_3C - \overset{OH}{\overset{|}{C}H} - CH_2 - \overset{O}{\overset{||}{C}} - H$$

iii. 

iv. 

$$CH_3 - \overset{O}{\overset{||}{C}} - CH_2 - CH_2 - CHO$$

v. 

$$CH_3CH_2\overset{\overset{CH_3}{|}}{C}H-\overset{\overset{O}{||}}{C}-\overset{\overset{CH_3}{|}}{C}H-CH_2CH_3$$

33. a. $NaCl(aq) \rightarrow Na^+(aq) + Cl^-(aq)$

$H_2O(Cl) \rightarrow (aq) + OH^-(aq)$

At cathode $2H^+(aq) + 2e^- \rightarrow H_2(g)$

It is because reduction potential value of $E^0{}_{(H^+/H_2)}$ is more than that of $E^0{}_{(H^+/H)}$

At anode: $2Cl^-(aq) - 2e^- \rightarrow Cl_2(g)$

It is because of over voltage i.e. energy required to liberate O_2 is more than that of Cl_2

Overall reaction:

$$2NaCl(aq) + 2H_2O(aq) \xrightarrow{Electrolysis} H_2(g) + Cl_2(g) + 2Na^+(aq) + 2OH^-(aq)$$

b. Zn | Zn^+ (0.1 M) | | Cd^{2+} (0.01 M) | Cd

$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$

$Cd^{2+}(aq) + 2e^- \rightarrow Cd(s)$

$Zn(s) + Cd^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cd(s)$

$E_{cell} = E^0{}_{cell} - \frac{0.0591}{2}\log\frac{[Zn^{2+}]}{[Cd^{2+}]}$

$= E^0_{(Cd^{2+}/Cd)} - E^0_{(Zn^{2+}/Zn)} - \frac{0.0591}{2}\log\frac{0.1}{0.01}$

$= -0.40V - (-0.76V) - \frac{0.0591}{2}\log 10$

= + 0.36 V - 0.0295

= 0.3305 V

OR

1. (i) H^+ ions are required for rusting to take place. Alkaline medium will react with H^+, therefore inhibit rusting.

   (ii) It is because zinc acts as anode because it is more reactive. ($E^\ominus_{(Zn^{2+}/Zn)} = -0.76\ V$ and $E^\ominus_{(Fe^{2+}/Fe)} = -0.44\ V$)

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

   Even if any Fe^{2+} is formed it will gain electrons and change into Fe and thus corrosion will be prevented.

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

2. From the data, it is found that standard emf of the Copper is less than Silver, therefore Copper is oxidized and Silver is reduced.

At Cathode (Reduction) :

$2Ag^{+}(aq) + 2e^{-} \rightarrow Ag(s)$

At Anode (Oxidation):

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

Cell representation of the cell is:

$Cu(s)|Cu^{2+}(aq)||Ag^{+}(aq)|Ag(s)$

Complete cell reaction is the summation of these two half cell reactions.

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

for this reaction **n** = **2 moles of electrons**

Now standard emf of the cell is

$E^{\ominus}_{cell} = E^{\ominus}{}_{(Ag^{+}/Ag)} - E^{\ominus}_{(cu^{2+}/cu)}$

= + 0.80 V - 0.34 V

= + 0.46 V

Nernst equation is

$E_{cell} = E^{\ominus}{}_{cell} - \frac{2.303RT}{nF}\log\frac{[Cu^{2+}]}{[Ag^{+}]}$

For this reaction, n = 2 , F = 96500 Cmol^{-1}, T = 298 K

$E_{cell} = E^{\ominus}_{cell} - \frac{0.0591}{2}\log\frac{[Cu^{2+}]}{[Ag^{+}]^{2}}$

$0 = 0.46\ V - \frac{0.0591}{2}\log\frac{[Cu^{2+}]}{[Ag^{+}]^{2}}$ (Given $E_{cell} = 0$)

$\log\frac{0.01}{[Ag+]^{2}} = \frac{0.46V \times 2}{0.0591} = \frac{0.92}{0.0591}$

= 15.567

$\log\frac{0.01}{[Ag+]^{2}} = 15.567$

$\frac{0.01}{[Ag+]^{2}} = anti\log(\ 15.567)$

$= 3.690 \times 10^{15}$

$[Ag^{+}]^{2} = \frac{0.01}{3.688 \times 10^{15}} = 2.71 \times 10^{-18}$

$\therefore [Ag^{+}] = 1.65 \times 10^{-9} mol\ L^{-1}$