CBSE
Class XII Chemistry
Sample Paper 4

Time: 3 Hrs **Total marks: 70**

General Instructions:

- There are 33 questions in this sample paper. All questions are compulsory.
- Section A: Q. Nos. 1 to 2 are case-based questions having four MCQs or Reason Assertion type based on given passage each carrying 1 mark.
- Section A: Question 3 to 16 are MCQs and Reason Assertion type questions carrying 1 mark each.
- Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
- Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
- Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
- Use of calculators and log tables is not permitted.

Section A

1. **Read the passage given below and answer the following questions:**

Previously the term “colloids” was used for a category of substances, however, later the term colloidal state of matter was preferred. Colloidal dispersions have been classified into different types depending upon the physical state of the dispersed phase and the dispersed medium or the nature of interactions between them or the nature of the colloidal particles. They are prepared in the industry or in the laboratory by a number of methods and then purified. Their properties have also been studied in detail. Hardy and Schulze made a substantial contribution in studying the coagulation of the colloids. The protective action of lyophilic colloids was studied by Zsigmondy and he introduced a term, called “gold number”.

(i) Lyophillic sols are more stable than lyophobic sols because
   a) the colloidal particles have positive change
   b) the colloidal particles have negative change
   c) the colloidal particles are solvated
   d) there is strong electrostatic repulsions between the particles

(ii) Which one of the following forms micelles in aqueous solution above certain concentration?
   a) Dodecyl trimethyl ammonium chloride
   b) Glucose
   c) Urea
   d) Pyridinium chloride

(iii) Identify the correct statement about colloids
   a) Colloidal sulfur is a substance.
   b) A colloid can be defined as homogenous system.
   c) A colloidal state is intermediate between a true solution and a suspension
   d) None of these.

(iv) Gold number is associated with
   a) Electrophoresis
   b) Amount of pure gold
   c) Protective colloid
   d) Precipitation of colloid

2. **Read the passage given below and answer the following questions:**

The noble gases have closed-shell electronic configuration and are monoatomic gases under normal conditions. The low boiling points of the lighter noble gases are due to weak dispersion forces between the atoms and the absence of other interatomic interactions.

The direct reaction of xenon with fluorine leads to a series of compounds with oxidation numbers +2, +4 and +6. XeF_4 reacts violently with water to given XeO_3. The compounds of Xenon exhibit rich stereochemistry and their geometries can be deduced considering the total number of electron pairs in the valence shell.

In these questions (Q. No. 5-8, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the followings).

a) Both assertion and reason are correct, and the reason is the correct explanation of the assertion.
b) Both assertion and reason are correct, but the reason is not the correct explanation of the assertion.
c) Assertion is correct, but reason is wrong.
d) Assertion is wrong, but reason is correct.

(i) **Assertion:** The structure of $XeOF_4$ is planar.
   Reason: $XeOF_4$ is octahedral with one position unoccupied.

(ii) **Assertion:** XeF_2 oxidizes Cl^- to Cl_2.
   Reason: XeF_2 is oxidizing agent.

(iii) **Assertion:** Argon is used in metallurgical process.
   Reason: Argon is having low reactivity with metal.

(iv) **Assertion:** XeF_4 reduces I_2 to I^-.
   Reason: XeF_4 is oxidizing agent.

Questions 3 to 11 are multiple choice questions:

3. Out of molality(m), molarity(M), formality(F) and mole fraction (X), those which are independent of temperature are-

a) M, m
b) F, X
c) m, X
d) M, X

4. People add sodium chloride to water while boiling eggs. This is too

a) decrease the boiling point
b) increase the boiling point
c) prevent the breaking of eggs
d) make eggs tasty

5. Which of the following is correct order for the bond dissociation enthalpy of halogen?

a) $Br_2>I_2>F_2>Cl_2$
b) $F_2>Cl_2>Br_2>I_2$
c) $I_2>Br_2>Cl_2>F_2$
d) $Cl_2>Br_2>F_2>I_2$

6. Which one will show optical isomerism?

a) $[Co(NH_3)_3Cl_3]$
b) Cis-$[Co(en)_2Cl_2]Cl$
c) Trans-$[Co(en)_2Cl_2]Cl$
d) $[Co(NH_3)_4Cl_2]Cl$

7. Aniline is less basic than ethylamine. This is due to

a) Conjugation of lone pair of nitrogen with the ring
b) The insoluble nature of aniline
c) Hydrogen bonding
d) None of these

8. The protective power of lyophilic colloidal sol is expressed in terms of

a) Coagulation value
b) Gold number
c) CMC (Critical Micelle Concentration)
d) Oxidation Numbers

9. DNA and RNA are chiral molecules, their chirality is due to

a) Chiral bases
b) Chiral Phosphate units
c) D-sugar component
d) L-sugar component

10. Which of the following is affected by catalyst?

a) Enthalpy
b) Entropy
c) Gibbs free energy
d) Activation energy

11. Acidified $K_2Cr_2O_7$ solution turns green when SO_2 gas is passed through it due to formation of

a) $Cr_2(SO_4)_3$
b) $Cr_2(SO_3)_3$
c) $CrSO_4$
d) None of these

In the following questions questions (Question number 12 to 16) a statement of assertion is followed by a statement of reason is given. Choose the correct answer out of the following choices.

a) Both assertion and reason are correct, and the reason is the correct explanation of the assertion.
b) Both assertion and reason are correct, but the reason is not the correct explanation of the assertion.
c) Assertion is correct, but reason is wrong.
d) Assertion is wrong, but reason is correct.

12. **Assertion:** In strongly acidic solution, aniline becomes more reactive towards electrophilic reagents.
Reason: The amino group being completely protonated in strongly acidic solution, the lone pair of electrons on nitrogen is no longer available for resonance.

13. **Assertion:** C_2H_5Br reacts with alcoholic solution of $AgNO_2$ to form nitroethane as the major product.
Reason: NO_2^- is an ambident ion.

14. **Assertion:** The instantaneous rate of reaction can be studied in chemical kinetics.
Reason: Ionic reactions occur instantaneously.

15. **Assertion:** Styrene on reaction with HBr gives 1-bromo-1-phenylethane.
Reason: Benzyl radical is more stable than alkyl radical.

16. **Assertion:** Aniline chloride is more acidic than ammonium chloride.
Reason: Aniline chloride is resonance stabilised.

Section B

The following questions Q. No. 17-25 are short answer type and carry 2 marks each.

17. State Henry's law. Give any one of its applications.

OR

What would be the molality of an aqueous solution which has a boiling point elevation of 1.00 K? (For H_2O, k_{bp} = 0.512 K kg mol^{-1})

18. Calculate the emf of the following cell at 298 K:

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

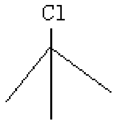
$$E^{\theta}_{Fe^{2+}|Fe} = -0.44\ V$$

19. Write the isomers of the compound having the formula C_4H_9Br.

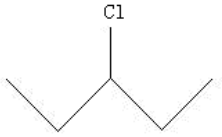
20. How will you prepare Cl_2 from HCl and HCl from Cl_2? Write the reactions only.

21. Which of the following undergoes S_N1 faster and why?

(a)



(b)

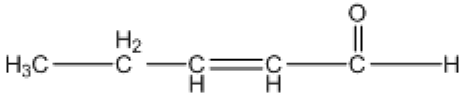


22. Arrange the following in the increasing order of acidic character:
HCOOH, $CH_2ClCOOH$, CF_3COOH, CCl_3COOH

OR

Write the IUPAC name of the following:

(a)



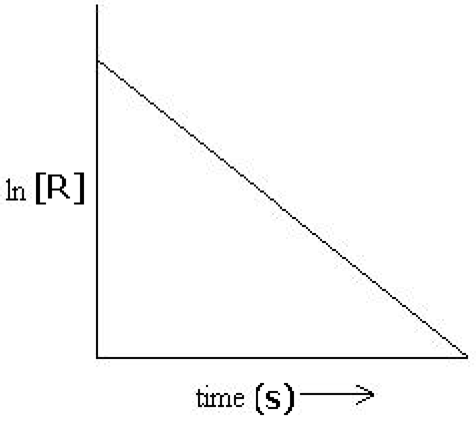
$H_3C-\overset{H_2}{C}-\underset{H}{C}=\underset{H}{C}-\overset{O}{\overset{\|}{C}}-H$

(b)

$Ph-\underset{H}{C}=\underset{H}{C}-CHO$

23. An antifreeze solution is prepared from 222.6 g of ethylene glycol $[C_2H_4(OH)_2]$ and 200 g of water. Calculate the molality of the solution. If the density of the solution is $1.072\ g\ mL^{-1}$, calculate its molarity.

24. For a certain chemical reaction, variation in concentration ln [R] vs time (s) plot is given below:



(a) What are the units of the rate constant k?
(b) What does the slope of the graph indicate?

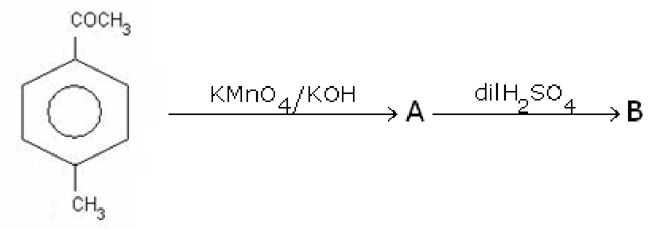
25. Account for the following:
(a) Nitration of aniline gives a substantial amount of m-nitroaniline.
(b) pK_b of aniline is more than that of methylamine.

Section-C

Q. No. 26-30 are short answer type II carrying 3 marks each.

26. Complete the equations:

(a)



(b)

$$CH_3(CH_2)_2CH_2OH \xrightarrow{\text{acidified } KMnO_4} X \xrightarrow[\Delta]{P_2O_5} Y$$

(c)

$$CH_3COCH_3 \xrightarrow{NH_2.NH_2} C \xrightarrow[\Delta]{KOH/\text{ethylene glycol}} D$$

27.
(a) What is aqua regia? Where is it used?
(b) Draw the shape of XeO_3. What is the hybridisation of Xe in XeO_3?
(c) Can PCl_5 act as both oxidising and reducing agent? Give reason to support your answer.

28. Account for the following:

(a) SO_2 is a powerful reducing agent in alkaline medium than in acidic medium.

(b) Compounds of fluorine and oxygen are called fluorides and not oxides.

(c) H_2S cannot be dried by passing over conc. H_2SO_4.

29.

(a) Why does NH_3 readily form complexes but NH_4^+ does not?

(b) Write the following:

(i) Ionisation isomer of $[Co(NH_3)_5Br]SO_4$

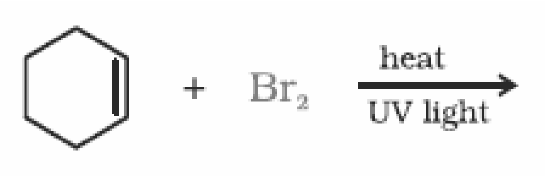
(ii) Linkage isomer of $[Co(NH_3)_5ONO]Cl_2$

30. Write the structure of the major organic product in each of the following reactions:

(i) $(CH_3)_3CBr + KOH \xrightarrow[\text{heat}]{\text{ethanol}}$

(ii) $C_6H_5CH_2Cl + C_2H_5ONa \rightarrow$

(iii)



Section-D

Q. No. 31 to 33 are long answer type carrying 5 marks each.

31.

(a) The decomposition of N_2O_5, $2N_2O_5\,g \rightleftharpoons 4NO_2\,g + O_2\,g$ is a first-order reaction. After 30 min from the start of decomposition in a closed vessel, the total pressure developed is found to be 284.5 mmHg. On complete decomposition, the total pressure is 584.5 mmHg. Calculate the rate constant of the reaction.

(b) The rate of a particular reaction quadruples when the temperature changes from 293 K to 313 K. Calculate the activation energy for the reaction.

OR

(a) ^{90}Sr has a half-life of 28.1 years. If 1 µg of ^{90}Sr was absorbed in the bones of a newborn, then how much of it will remain after 20 years if not lost metabolically?

(b) For the reaction $2A + B \rightarrow A_2B$, the rate constant is $0.5\ mol^{-1}Ls^{-1}$.

Rate law is rate = $k[A]^2$. Calculate the rate when

(i) $[A] = 0.60\ mol\ L^{-1}$, $[B] = 0.05\ mol\ L^{-1}$

(ii) Concentrations of A and B are reduced to $\frac{1}{4}$.

32.

(a) Predict the product of electrolysis on each of the following:

(i) Aqueous solution of $CuSO_4$ at copper electrodes

(ii) Aqueous solution of $CuCl_2$ with platinum electrodes

(b) Three electrolytic cells A, B and C containing solutions of $ZnSO_4$, $AgNO_3$ and $CuSO_4$ are connected in series. A steady current of 1.5 amperes was passed through until 1.45 g of silver deposited at the cathode of cell B. How long did the current flow? What mass of copper and zinc was deposited? (Molar mass of Zn = 65.4, Ag = 107.9, Cu = 63.5)

OR

(a) In a button cell, widely used in watches and other devices, the following reaction takes place:

$$Zn(s) + Ag_2O(s) + H_2O(l) \longrightarrow Zn^{2+}(aq) + 2Ag(s) + 2OH^-(aq)$$

Determine E^θ_{cell} and $\Delta_r G^\circ$ for the reaction. Given

$$E^\theta_{Ag^+/Ag} = +0.80\ V,\ E^\theta_{Zn^{2+}/Zn} = -0.76\ V$$

(b) Explain with examples the terms weak and strong electrolytes. How can these be distinguished?

33.

(a) Which of the following ions would form white complexes: Cu^{2+}, Zn^{2+}, Ti^{3+}, V^{4+}. Why?

(b) What happens when (write the balanced chemical reactions):

(i) Acidified potassium permanganate solution reacts with aqueous potassium iodide solution. Write the colour change taking place if any.

(ii) Acidified solution of potassium dichromate reacts with aqueous solution of Sn(II) chloride. Write the colour change taking place if any.

OR

Give reasons:

(a) Cr^{2+} is a strong reducing agent, whereas Mn^{2+} is not. (Cr = 24, Mn = 25)

(b) Transition metal ions such as Cu^+, Ag^+ and Sc^{3+} are colourless.

(c) Enthalpies of atomisation of transition metals of 3d series do not follow a regular trend throughout the series.

(d) The radius of Fe^{2+} (Z = 26) is less than that of Mn^{2+} (Z = 25).

Chemistry of actinoids is more complicated than that of lanthanoids.

CBSE
Class XII Chemistry
Sample Paper 4 - Solution

Time: 3 Hrs **Total Marks: 70**

Section A

1.

(i) (c) This is because the lyophobic sols get precipitated by the addition of electrolytes whereas lyophilic sols do not.

(ii) (a) Dodecyl trimethyl ammonium chloride forms micelles at critical micelle concentration (CMC).

(iii) (c) A colloidal state is intermediate between a true solution and a suspension. For example, Sulphur is a substance, but colloidal sulphur is sulphur dispersed in water, in which sulphur atoms combine to form multimolecules.

(iv) (b) Gold number is associated with gold sol and is used to compare the protective action of different lyophilic colloids.

2.

(i) (d) The structure of $XeOF_4$ is not planar. $XeOF_4$ is octahedral with one position unoccupied.
(ii) (a) XeF_2 oxidizes Cl^- to Cl_2, because XeF_2 is oxidizing agent.
(iii) (a) Argon is used in metallurgical process, because it is having low reactivity.
(iv) (d) XeF_4 oxidizes I_2 to I^-. XeF_4 is oxidizing agent.

3. (c) Molality and Mole fraction does not depend on temperature.

4. (b) People add sodium chloride to water while boiling eggs. This is to increase the boiling point.

5. (d) In F_2, therefore, electronic repulsion, therefore, bond dissociation is less.

6. (b) will show optical isomerism because it does not have symmetry and polydentate ligand.

7. (a) Aniline is less basic than ethylamine because of conjugation of lone pair of nitrogen with ring.

8. (b) Gold number measures protective power of colloids. Lower the gold number more will be protective power, e.g., gelatin.

9. (c) DNA and RNA are chiral molecules, their chirality is due to D-sugar component.

10. (d) Enthalpy, Entropy, Gibbs free energy are unaffected by catalyst. Activation energy is affected by catalyst.

11. (a) Acidified $K_2Cr_2O_7$ solution turns green when SO_2 gas is passed through it due to formation of $Cr_2(SO_4)_3$.

12. (d) Assertion is wrong, but reason is correct.

13. (b) Both assertion and reason are correct, but the reason is not the correct explanation of the assertion.

14. (a) Both assertion and reason are correct, and the reason is the correct explanation of the assertion.

15. (c) Assertion is correct, but reason is wrong.

16. (c) Assertion is correct, but reason is wrong.

Section B

17. Henry's law states that solubility of a gas in a liquid at a given temperature is directly proportional to the pressure of a gas. If we use mole fraction of a gas in the solution as a measure of its solubility, then it can be said that the mole fraction of a gas in the solution is proportional to the partial pressure of the gas over the solution.

$p = K_H \cdot x$

Application: Soft drinks contain dissolved carbon dioxide. In the preparation of these beverages, carbon dioxide is passed at high pressure to increase its solubility.

OR

Using the relation, $T_{b.p.(solution)} = T_{b.p.(l)} + k_{b.p.} \times m$

Solving for m, we get $m = \dfrac{T_{b.p.(solution)} - T_{b.p.(l)}}{k_{b.p.}}$

$$m = \frac{\Delta T_{b.p.}}{k_{b.p.}} = \frac{1.00\,K}{0.512\,K\,kg\,mol^{-1}} = 1.95\,mol\,kg^{-1}$$

18. $Fe + 2H^+ \rightarrow Fe^{2+} + H_2$

$$E = E^{\theta} - \frac{0.059}{n} \log \frac{[Fe^{2+}]}{[H^+]^2}$$

$$E^{\theta} = E^{\theta}_{cathode} - E^{\theta}_{anode}$$

$$= 0 - (-0.44V)$$

$$= 0.44\ V$$

$$E = E^{\theta} - \frac{0.059}{2} \log \frac{0.001}{1}$$

$$= 0.44 - \frac{0.059}{2} \log \frac{0.001}{1}$$

$$= 0.5285\ V$$

19.

(a) $CH_3CH_2CH_2\ CH_2Br$

(b) $CH_3CH_2\ CH\ (Br)CH_3$

(c) $CH_3CH(CH_3)\ CH_2Br$

(d) $CH_3CBr(CH_3)\ CH_3$

20.

(a) $4HCl + MnO_2 \longrightarrow MnCl_2 + Cl_2 + 2H_2O$

(b) $H_2 + Cl_2 \xrightarrow{\text{Diffused sunlight}} 2HCl$

21. Compound (a) reacts faster than compound (b).

This is due to the formation of a more stable (3°) carbocation in compound (a) in the rate-determining step than (2°) carbocation in compound (b).

22. The increasing order of the acidic character of the given species is as follows:

$CF_3COOH > CCl_3COOH > CH_2ClCOOH > HCOOH$

OR

(a) pent-2-enal

(b) 3-phenyl prop-2-enol

23. Molality

$$= \frac{222.6}{62 \times 0.2} = 17.95\ m$$

Mass of solution = 200 + 222.6 = 422.6 g

$$\text{Density of solution} = \frac{\text{Mass of solution}}{\text{Volume of solution}}$$

$$1.072\ g\ mL^{-1} = \frac{422.6\ g}{\text{Volume of solution}}$$

$$\text{Volume of solution} = 394.22\ mL$$

$$\text{Molarity} = \frac{w_B}{M_B} \times \frac{1000}{\text{Volume of solution (in mL)}}$$

$$= \frac{222.6}{62} \times \frac{1000}{394.22}$$

$$= 9.1\ \text{M}$$

24.

(a) s^{-1}

(b) Slope = −k

25.

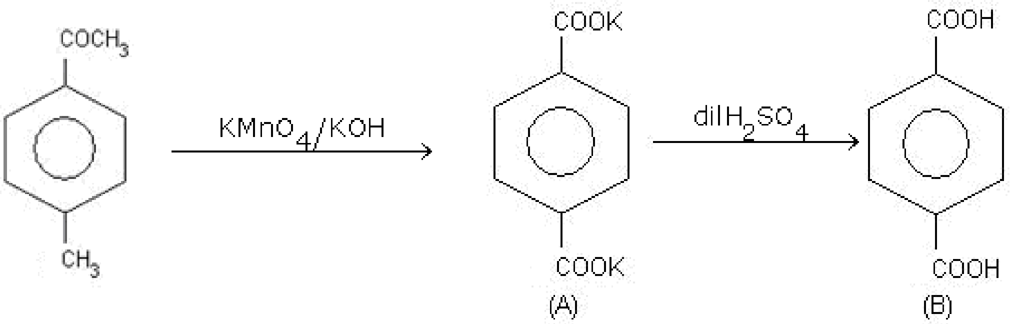
(a) ___In the presence of nitrating mixture $(HNO_3 + H_2SO_4)$, aniline gets protonated to form anilinium ion, which is a meta-directing group, thus giving a substantial amount of m-nitroaniline.

(b) In aniline, a lone pair of electrons on the N atom is delocalised over the benzene ring, resulting in lowering its basic strength. Hence, its K_b value will be lower and its pK_b value will be higher. On the other hand, the +I effect of the $-CH_3$ group increases the electron density on the N atom in CH_3NH_2 making it a stronger base. Hence, its K_b value will be higher and its pK_b value will be lower.

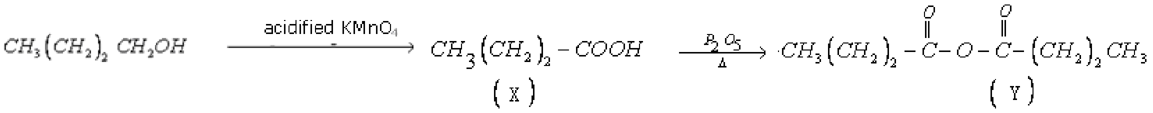
Section C

26.

(a)

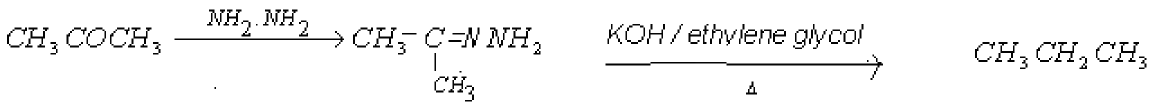


(b)



$$CH_3(CH_2)_2CH_2OH \xrightarrow{\text{acidified } KMnO_4} \underset{(X)}{CH_3(CH_2)_2-COOH} \xrightarrow[\Delta]{P_2O_5} \underset{(Y)}{CH_3(CH_2)_2-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-(CH_2)_2CH_3}$$

(c)



$$CH_3COCH_3 \xrightarrow{NH_2.NH_2} CH_3-\underset{CH_3}{\underset{|}{C}}=N\,NH_2 \xrightarrow[\Delta]{KOH/ethylene\ glycol} CH_3CH_2CH_3$$

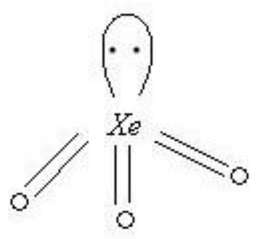
(C) (D)

27.

(a) Aqua regia is three parts of conc. HCl and one part of conc. HNO_3. It is used to dissolve noble metals.

$$Au + 4H^+ + NO_3^- + 4Cl^- \rightarrow AuCl_4^- + NO + 2H_2O$$

(b)



Hybridisation is sp^3.

(c) No, PCl_5 cannot act as both oxidising and reducing agent.

The oxidation state of P in PCl_5 is + 5, which is maximum for P. P^{+5} can only reduce itself, thus serving as an oxidising agent.

28.

(a) $SO_2 + 2OH^- \rightleftharpoons SO_4^{2-} + 2H^+ + 2e^-$

Addition of acid increases H^+ ion concentration. This leads to the backward shifting of the reaction. Thus, SO_2 fails to serve as a reducing agent in acidic medium. In alkaline medium, OH^- removes H^+ and shifts the reaction in the forward direction.

(b) This is because of higher electronegativity of F compared to O. In compounds of O and F, F has a negative oxidation state, and thus, these compounds are called fluorides.

(c) H_2SO_4 cannot be used as a drying agent as it reacts with H_2S as follows:

$$H_2SO_4 + H_2S \rightarrow 2H_2O + SO_2 + S$$

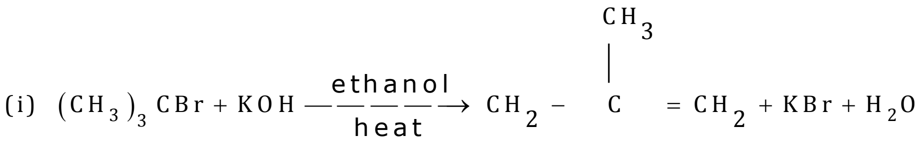
29.

(a) NH_3 contains a lone pair of electrons which coordinate with a metal ion to form a complex compound. However, in NH_4^+ ion, the lone pair is bound to H^+ and therefore is not available for bonding to the metal ion. Therefore, NH_4^+ does not form complexes readily.

(b) (i) Ionisation isomer of $[Co(NH_3)_5Br]SO_4$ is $[Co(NH_3)_5SO_4]Br$.

(ii) Linkage isomer of $[Co(NH_3)_5ONO]Cl_2$ is $[Co(NH_3)_5NO_2]Cl_2$.

30.

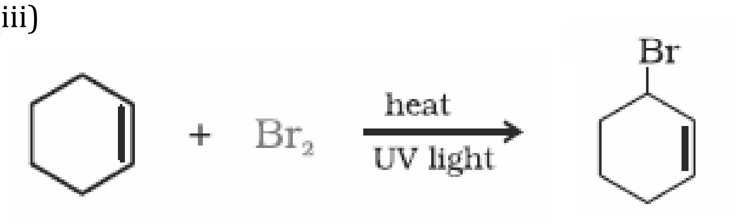


(i) $(CH_3)_3CBr + KOH \xrightarrow[\text{heat}]{\text{ethanol}} CH_2 - \overset{\overset{CH_3}{|}}{C} = CH_2 + KBr + H_2O$

2 – Methylprop-1-ene

(ii) $C_6H_5CH_2Cl + C_2H_5ONa \longrightarrow C_6H_5CH_2OC_2H_5 + NaCl$

(iii)



Section D

31.

(a) $2N_2O_5(g) \rightleftharpoons 4NO_2(g) + O_2(g)$

2 moles of gaseous N_2O_5 on complete decomposition gives 5 moles of gaseous product (4 moles of NO_2 and 1 mole of O_2).

Initial pressure of N_2O_5, $p_0 = 584.5 \times \frac{2}{5}$

$= 233.8$ mmHg

Let the pressure of N_2O_5 decrease by x atm.

So, after 30 minutes, the pressure due to $N_2O_5 = 233.8 - x$.

Pressure due to $NO_2 = 2x$

Pressure due to $O_2 = x/2$

Total pressure after 30 min = 284. 5 mmHg

$$233.8 - x + 2x + \frac{x}{2} = 284.5$$

$$x = 33.8\ mm\ Hg$$

Pressure of N_2O_5 after 30 min = 233.8 – 33.8

= 200 mmHg

For a first-order reaction,

$$k = \frac{2.303}{t} \log \frac{(p_0)}{(p_t)}$$

$$= \frac{2.303}{30} \log \frac{233.8}{200}$$

$= 5.2 \times 10^{-3}\ min^{-1}$.

(b)

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

$k_2 = 4k_1$

$$\log 4=\frac{E_a}{2.303\times 8.314}\left(\frac{1}{293}-\frac{1}{313}\right)$$

$E_a = 52.85$ kJ/mol

OR

(a) For a first-order reaction,

$$k=\frac{0.693}{t_{1/2}}=\frac{0.693}{28.1}=0.0247\ \text{years}^{-1}$$

After 20 years,

$$t=\frac{2.303}{k}\log\frac{N_0}{N}$$

$$20=\frac{2.303}{0.0247}\log\frac{10^{-6}}{N}$$

$N = 6.1\times10^{-7}$ g

(b) Rate $= k[A]^2$

(i) Rate $= k[0.6]^2$

$= 0.5\times0.6\times0.6$

$= 0.18$

(ii) The rate depends only on the concentration of A and is independent of B.

Therefore, if the concentration of A is reduced to one-fourth, it becomes $\frac{0.6}{4}$.

Now, the rate becomes

$$\text{Rate}=0.5\times\left(\frac{0.6}{4}\right)^2$$

$$=\frac{0.5\times0.6\times0.6}{4\times4}=0.011$$

32.

(a) (i) At the cathode:

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

At the anode:

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

(ii) At the cathode:

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

At the anode:

$Cl^- \rightarrow Cl + e^-$

$Cl + Cl \rightarrow Cl_2$

(b) Reactions involved:

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

$Ag^+ + e^- \rightarrow Ag$

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

107. 9 g of silver is deposited by 96500 C.

1.45 g of silver is deposited by $= \frac{96500}{107.9} \times 1.45 = 1297\,C$

$Q = I \times t$

$t = \frac{Q}{I}$

$= \frac{1297}{1.5} = 864\,s$

2 x 96500 C of electricity deposit zinc = 65.4 g Zn

1297 C of electricity deposit zinc $= \frac{65.4 \times 1297}{2 \times 96500}$

$\therefore$ Mass of zinc = 0.44g

2 x 96500 C of electricity deposit copper = 63.5 g

1297 C of electricity deposit copper $= \frac{63.5 \times 1297}{2 \times 96500}$

$\therefore$ Mass of zinc = 0.427g

OR

(a) In this cell, zinc is oxidised and silver is reduced.

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

$= E^\theta_{Ag^+/Ag} - E^\theta_{Zn^{2+}/Zn}$

$= 0.80 - (-0.76)$

$= +1.56\,V$

$\Delta_r G^\circ = -nFE^\theta_{cell}$

$= -2 \times 96500 \times 1.56$

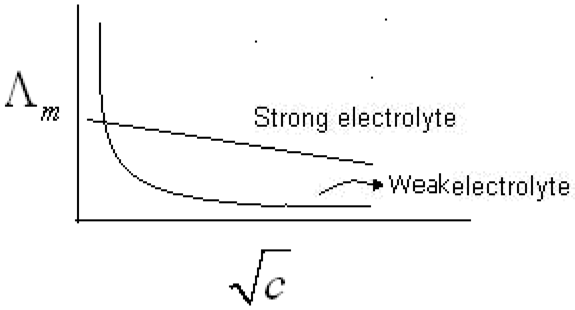
$= -301080\,J\,mol^{-1}$

(b) Electrolytes which are ionised almost completely in aqueous solution are called strong electrolytes. Examples: H_2SO_4, $NaCl$.

Electrolytes which ionise to a small extent are called weak electrolytes. Examples: CH_3COOH, NH_4OH

These electrolytes can be distinguished by their conducting power which is expressed in terms of degree of ionisation (α). For strong electrolytes, α is almost equal to 1, but for weak electrolytes, α has a value smaller than 1.

If we plot a graph of molar conductivity, Λ_m vs $\sqrt{c}$, for strong electrolytes, we get a straight line in which Λ_m increases slowly with dilution, whereas for weak electrolytes, Λ_m increases steeply on dilution.



33.

(a) Zn^{2+} will form white complexes because it does not have unpaired electrons. So, d–d transitions responsible for colour are not possible.

(b) (i) I_2 is liberated and the pink colour of $KMnO_4$ solution disappears

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

(ii) Tin(II) chloride is oxidised to tin(IV) chloride and the orange colour of $K_2Cr_2O_7$ solution turns green.

$Cr_2O_7^{2-} + 3Sn^{2+} + 14H^+ \rightarrow 2Cr^{3+} + 3Sn^{4+} + 7H_2O$

OR

(a) For chromium, the +III oxidation state ($3d^3$) is more stable as compared to the +II state ($3d^4$). Therefore, Cr^{2+} readily changes to Cr^{3+} and behaves as a strong reducing agent. On the other hand, for manganese, the +II state is more stable than the +III state. Hence, Mn^{3+} ($3d^4$) readily changes to Mn^{2+} ($3d^5$) by gaining an electron and behaves as a strong oxidising agent.

(b) All these ions have no unpaired electrons. The d–d transitions responsible for colour are not possible.

(c) In the 3d series, the strength of the metallic bond increases up to the middle with an increasing number of unpaired electrons. After Cr, the number of unpaired electrons decreases. Accordingly, the enthalpies of atomisation decrease after Cr. The dip at Mn is due to a stable electronic configuration. Its electrons are more tightly held by the nucleus, and so, the metallic bond is weak.

(d) For ions of the same charge, the ionic radius decreases with increasing atomic number. This is because the extra electrons enter a d-orbital each time the nuclear charge increases by unity. The shielding effect of a d-electron is small, the net electrostatic attraction between the nucleus and outermost electrons increases and the ionic radius decreases.

(e) The chemistry of actinides is more complex in view of their ability to exist in different oxidation states. Moreover, many of the actinides are radioactive, which makes the study of these elements rather difficult.