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 XeOF₄ is not planar. XeOF₄ is octahedral with one position unoccupied.
- (ii) (a) XeF_2 oxidizes Cl^2 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 F₂, 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 K₂Cr₂O₇ solution turns green when SO₂ gas is passed through it due to formation of Cr₂(SO₄)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, $T_{b.p.(solution)} = T_{b.p.(1)} + k_{b.p.} \times m$

Solving for m, we get m=
$$\frac{T_{b.p.(solution)} - T_{b.p.(1)}}{k_{b.p.}}$$

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

18. Fe + 2H⁺ \rightarrow Fe²⁺ + H₂

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

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

= 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) CH₃CH₂CH₂ CH₂Br
(b) CH₃CH₂ CH (Br)CH₃
(c) CH₃CH(CH₃) CH₂Br
(d) CH₃CBr(CH₃) CH₃

20.

- (a) $4 \text{H} \text{Cl} + \text{M} \text{n} \text{O}_2 \longrightarrow \text{M} \text{n} \text{Cl}_2 + \text{Cl}_2 + 2 \text{H}_2 \text{O}$ (b) $\text{H}_2 + \text{Cl}_2 \longrightarrow \frac{\text{Diffused sunlight}}{2} 2 \text{H} \text{Cl}$
- **21.** Compound (a) reacts faster than compound (b).

This is due to the formation of a more stable ($3\,^\circ$) $\,$ 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: CF₃COOH > CCl₃COOH > CH₂ClCOOH > HCOOH

OR

(a) pent-2-enal(b) 3-phenyl prop-2-enol

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23. Molality
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$$= \frac{222.6}{62 \times 0.2} = 17.95 \text{ m}$$

Mass of solution = 200 + 222.6 = 422.6 g
Density of solution = $\frac{\text{M ass of solution}}{\text{Volume of solution}}$
1.072 g m L⁻¹ = $\frac{422.6 \text{ g}}{\text{Volume of solution}}$

Volume of solution = 394.22 mL

Molarity =
$$\frac{W_B}{M_B} \times \frac{1000}{\text{Volume of solution (in m L)}}$$

= $\frac{222.6}{62} \times \frac{1000}{394.22}$
= 9.1 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 $CH_3 N H_2$ making it a stronger base. Hence, its K_b value will be higher and its pK_b value will be lower.



26.



(b)

(c)

$$CH_{3}COCH_{3} \xrightarrow{NH_{2} NH_{2}} CH_{3}^{-}C = N NH_{2} \xrightarrow{KOH / ethvlene glycol} CH_{3}CH_{2}CH_{3}$$

$$(C) \qquad (D)$$

27.

(a) Aqua regia is three parts of conc. HCl and one part of conc. HNO₃. It is used to dissolve noble metals.

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Au + 4H^+ + NO_3^- + 4C1^- \rightarrow AuCl_4^- + NO + 2H_2O
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(b)



Hybridisation is sp³.

(c) No, PCl₅ 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:

$$H_{2}SO_{4} + H_{2}S \rightarrow 2H_{2}O + SO_{2} + SO_{3}$$

29.

- (a) NH₃ contains a lone pair of electrons which coordinate with a metal ion to form a complex compound. However, in NH₄⁺ ion, the lone pair is bound to H⁺ and therefore is not available for bonding to the metal ion. Therefore, NH₄⁺ does not form complexes readily.
- (b) (i) Ionisation isomer of [Co(NH₃)₅Br]SO₄ is [Co(NH₃)₅ SO₄]Br.

(ii) Linkage isomer of [Co(NH₃)₅ONO]Cl₂ is [Co(NH₃)₅NO₂]Cl₂.

30. (i)
$$(CH_3)_3 CBr + KOH \xrightarrow{\text{ethanol}} CH_2 - C = CH_2 + KBr + H_2O$$

 $2 - Methylprop - 1 - ene$
(ii) $C_6 H_5 CH_2 Cl + C_2 H_5 ONa \longrightarrow C_6 H_5 CH_2 OC_2 H_5 + NaCl$
(iii)
 $+ Br_2 \xrightarrow{\text{heat}} VV \text{ light}$

Section D

31.

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

(a) 2 moles of gaseous N_2O_5 on complete decomposition gives 5 moles of gaseous product (4 moles of NO₂ and 1 mole of O_2).

Initial pressure of N₂O₅, p₀ = 584.5 × $\frac{2}{5}$

= 233.8 mmHg

Let the pressure of N₂O₅ 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 $N_2 O_5$ after 30 min = 233.8 – 33.8

= 200 mmHg

For a first-order reaction,

$$k = \frac{2.303}{t} \log \frac{(p_0)}{(p_t)}$$
$$= \frac{2.303}{30} \log \frac{233.8}{200}$$
$$= 5.2 \times 10^{-3} \text{ min}^{-1}.$$

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

 $k_2 = 4k_1$

(b)

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

(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,

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

$$2 0 = \frac{2.303}{0.0247} \log \frac{10^{-6}}{N}$$

$$N = 6.1 \times 10^{-7} \text{ g}$$
(b) Rate = k [A]²
(i) Rate = k [0.6]²
= 0.5 × 0.6 × 0.6
= 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

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

= $\frac{0.5 \times 0.6 \times 0.6}{4 \times 4} = 0.011$

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: $Cl \rightarrow Cl + e^{-1}$ $Cl + Cl \rightarrow Cl_2$ (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 = $\frac{96500}{107.9} \times 1.45 = 1297 \text{ C}$ $Q = I \times t$ $t = \frac{Q}{r}$ $=\frac{1297}{15}=864$ 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.

$E_{cell}^{\theta} = E_{cathode}^{\theta} - E_{anode}^{\theta}$	$\Delta G^{\circ} = -n F E^{\theta}$
$= E^{\theta} - E^{\theta}$	cell
Ag^+/Ag Zn^{2+}/Zn	= -2 × 96500 × 1.56
= 0.80 - (-0.76)	$= -301080 \text{ Jm ol}^{-1}$
= +1.56 V	

(b) Electrolytes which are ionised almost completely in aqueous solution are called strong electrolytes. Examples: H₂ SO₄, NaCl.

Electrolytes which ionise to a small extent are called weak electrolytes. Examples: $CH_{3}COOH, NH_{4}OH$

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, $\Lambda_m vs \sqrt{c}$, 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) Zn²⁺ 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 (3d³) is more stable as compared to the +II state (3d⁴). Therefore, Cr²⁺ readily changes to Cr³⁺ and behaves as a strong reducing agent. On the other hand, for manganese, the +II state is more stable than the +III state. Hence, Mn³⁺ (3d⁴) readily changes to Mn²⁺ (3d⁵) 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.