Solved Paper 2013

CHEMISTRY

Time : 3 Hours **Class-XII** **Max. Marks : 70**

General Instructions:

(i) All questions are compulsory.

*(ii) Question numbers **1** to **8** are very short-answer questions and carry **1** mark each.*

*(iii) Question numbers **9** to **18** are short-answer questions and carry **2** marks each.*

*(iv) Question numbers **19** to **27** are also short-answer questions and carry **3** marks each.*

*(v) Question numbers **28** to **30** are long-answer questions and carry **5** marks each.*

*(vi) Use Log Tables, if necessary. Use of calculators is **not** allowed.*

*** 1. How many atoms constitute one unit cell of a face-centered cubic crystal? 1**

*** 2. Name the method used for the refining of Nickel metal. 1**

*** 3. What is the covalency of nitrogen in N_2O_5? 1**

4. Write the IUPAC name of

$$CH_3 - \underset{\displaystyle Cl}{\underset{|}{CH}} - CH_2 - CH = CH_2$$ **1**

Ans. 4-chloro pent-1-ene

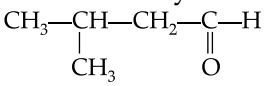
5. What happens when $CH_3 - Br$ is treated with KCN? 1

Ans. When CH_3–Br react with KCN, it produce methylnitrile. It is a nucleophilic substitution reaction which take place by SN^2 Mechanism

$$CH_3 - Br + KCN \longrightarrow CH_3 - CN + KBr$$

6. Write the structure of 3-methyl butanal. 1

Ans.



3-methyl butanal

7. Arrange the following in increasing order of their basic strength in aqueous solution:
CH_3NH_2, $(CH_3)_3N$, $(CH_3)_2NH$ 1

Ans. Primary amine is more basic due to presence of two hydrogen bonds which have intermolecular association between two hydrogen and one nitrogen atom. Secondary amine is more basic than tertiary amine in aqueous solution because of steric factor. So, order of basicity is:

$$CH_3 - NH_2 > (CH_3)_2 - NH > (CH_3)_3 - N$$

8. What are three types of RNA molecules which perform different functions? 1

Ans. There are three types of RNA which perform different function:

(i) t-RNA (transfer RNA)

(ii) r-RNA (Ribosomal RNA)

(iii) m-RNA (messenger RNA)

9. 18 g of glucose, $C_6H_{12}O_6$ (Molar Mass = 180 g mol^{-1}) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil?
(K_b for water = 0.52 K kg mol^{-1}, boiling point of pure water = 373.15 K) 2

Ans.

$$\Delta T = \frac{K_b \times W_B \times 1000}{m_B \times W_A}$$

$$\Delta T = \frac{0.52 \times 18 \times 1000}{180 \times 1000} = 0.052$$

$$T - T_b = 0.052$$

$$T - 373 = 0.052$$

$$T = 373 + 0.052$$

$$T = 373.052 \text{ K}$$

10. The conductivity of 0.20 M solution of KCl at 298K is 0.025 S cm^{-1}, Calculate its molar conductivity. 2

Ans.

$$\text{Conductivity} = 0.025 \text{ S cm}^{-1}$$

$$\text{molarity, M} = 0.20 \text{ M}$$

$$T = 298 \text{ K}$$

$$T_m = ?$$

$$\text{molar conductivity} = ?$$

$$T_m = \frac{\kappa \times 1000}{C}$$

$$= \frac{0.025 \times 1000 \text{ S cm}^{-1}}{0.20 \text{ mol cm}^{-3}}$$

$$= \frac{25}{0.20}$$

$$= 125 \text{ S cm}^2 \text{ mol}^{-1}$$

*** 11. Write the dispersed phase and dispersion medium of the following colloidal systems:**

(i) Smoke

(ii) Milk 2

* *Out of Syllabus*

OR

What are lyophilic and lyophobic colloids? Which of these sols can be easily coagulated on the addition of small amounts of electrolytes?

*** 12. Write the differences between physisorption and chemisorption with respect to the following:**

(i) Specificity

(ii) Temperature dependence

(iii) Reversibility and

(iv) Enthalpy change **2**

*** 13. (a) Which solution is us ed for the leaching of silver metal in the of silver?**

(b) Out of C and CO, which is a better reducing agent at the lower temperature range in the blast furnace to extract iron from the oxide ore? **2**

*** 14. What happens when**

(i) PCl, is heated ?

(ii) H_3PO_3 is heated ?

Write the reactions involved. **2**

15. (a) Which metal in the first transition series (3*d* series) exhibits +1 oxidation state most frequently and why?

(b) Which of the following cations are coloured in aqueous solutions and why?

Sc^{3+}, V^{3+}, Ti^{4+}, Mn^{2+}

(At. Nos. Sc = 21, V = 23, Ti = 22, Mn = 25) **2**

Ans. (a) Copper metal shows +1 oxidation state because its electronic configuration is $[Ar]3d^{10}4s^1$.

It can easily donate one electron from $4s^1$ and exhibit +1 oxidation state.

(b) V^{3+} and Mn^{2+} are coloured transition metal because of presence of unpaired electron and shows *d-d* transition. While Sc^{3+} and Ti^{4+} are colourless because here *d*-orbitals are empty and there is no *d-d* transition take place.

16. Chlorobenzene is extremely less reactive towards a nucleophilic substitution reaction. Give two reasons for the same. **2**

Ans. (a) In Chlorobenzene structure, chlorine is attached with a benzene ring through single bond and it is highly electronegative in nature. Thats why any electronegative/electrophilic agent can not replace it.

(b) There is delocalization of lone pair of electron present on chlorine atom. Carbon atom of benzene ring is Sp^2 hybridized. Its structure is stabilized by resonance, so replacement of chlorine atom with other nucleophilic substance will required lots of energy which is not favourable.

17. Explain the mechanism of the following reaction:

$2CH_3 - CH_2 - OH \xrightarrow[413K]{H^+} CH_3 - CH_2 - O - CH_2 - CH_3 + H_2O$

Ans. $2CH_3CH_2OH \xrightarrow[C_2H_5OH.410K \text{ (in excess)}]{\text{Heat with } H_2SO_4} CH_3CH_2OH$

$$CH_3CH_2-\ddot{O}-H \xrightarrow{H^+} CH_3CH_3-\overset{\oplus}{O}-H \quad (H \text{ below O})$$

Step II:

$$CH_3CH_2-\overset{\oplus}{\ddot{O}}-H \longrightarrow CH_3-CH_3^{\oplus} + H_2O \quad (H \text{ below O})$$

$$CH_3CH_2-\ddot{O}-H + CH_3CH_2^{\oplus} \longrightarrow CH_3 + CH_2-\overset{H}{\overset{|}{\overset{\oplus}{O}}}-CH_2CH_3$$

$$CH_3CH_2-\overset{\oplus}{O}(H)-CH_2CH_3 \longrightarrow CH_3CH_2-O-CH_2-CH_3 + H^{\oplus}$$

$$HSO_4^- + H^+ \longrightarrow H_2SO_4$$

(iii) $CH_3-CH_2^{\oplus} + CH_3-CH_2-OH \xrightarrow{-H^{\oplus}} CH_3-CH_2-O-CH_2-CH_3$

18. How will you convert:

(i) Propene to Propan-2-ol ?

(ii) Phenol to 2, 4, 6 – trinitrophenol?

Ans. (a) Propene to prop-2-ol

$CH_3-CH=CH_2 \underset{}{\overset{H_2O}{\rightleftharpoons}} CH_3-\underset{OH}{\underset{|}{CH}}-CH_3$

propene — prop-2-ol

(b) Phenol to 2, 4, 6 trinitrophenol

OH^- (Phenol) $+3$ conc. $HNO_3 \xrightarrow{Conc.H_2SO_4}$ 2, 4, 6 trinitro phenol (OH, NO_2, NO_2, NO_2)

*** 19. (a) What type of semiconductor is obtained when silicon is doped with boron?**

(b) What type of magnetism is shown in the following alignment of magnetic moments?

↑ ↑ ↑ ↑ ↑ ↑

(c) What type of point defect is produced when AgCl is doped with $CdCl_2$? **3**

20. Determine the osmotic pressure of a solution prepared by dissolving 2.5×10^{-2} g of K_2SO_4 in 2L of water at 25°C, assuming that it is completely dissociated.

($R = 0.0821$ L atm K^{-1} mol^{-1}, Molar mass of K_2SO_4 = 174 g mol^{-1}). **3**

Ans. Reaction is:

$$K_2SO_4 \longrightarrow 2K^+ + SO_4^{2-}$$

No. of produced ions = 3

$$\pi = iCRT$$

$$\pi = \frac{3 \times 0.025 \times 0.0821 \times 0.5 \times 298}{174}$$

$$= \frac{0.917}{174}$$

$$= 0.00527$$

* *Out of Syllabus*

$= 5.27 \times 10^{-3}$ atm

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

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

(Given E°_{cell} = + 0.44 V) **3**

Ans. According to given equation:

$$Fe(s) + 2H^+(aq) \longrightarrow Fe^{+2}(aq) + H_2(g)$$

$$E^\circ_{cell} = 0.44 \text{ V}$$

By applying Nernst equation:

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n}\log\frac{Fe^{+2}}{[H^+]^2}$$

$$E_{cell} = 0.44 - \frac{0.0591}{2}\log\frac{0.001}{(1)^2}$$

$$E_{cell} = 0.44 - 0.0295 \log 10^{-3}$$

$$E_{cell} = 0.44 - 0.0295 (-3 \log 10)$$

where [log 10 = 1]

$$= 0.44 - 0.0295(-3 \times 1)$$

$$= 0.44 + 0.0885$$

$$E_{cell} = 0.528 \text{ V}$$

22. How would you account for the following?

(i) Transition metals exhibit variable oxidation states.

(ii) Zr(Z = 40) and Hf(Z = 72) have almost identical radii.

(iii) Transition metals and their compounds act as catalyst. **3**

OR

Complete the following chemical equations:

(i) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \longrightarrow$

(ii) $2CrO_4^{2-} + 2H^+ \longrightarrow$

(iii) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow$ **3**

Ans. (i) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \longrightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O$

(ii) $2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$

(iii) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

OR

(i) Transition metals shows variable oxidation state because they have tendency to loose electron from their penultimate *d*-subshell and exhibit various oxidation state.

(ii) Zr and Hf have almost same radii because of lanthanoid contraction. Filling up of electrons in 4*f* series shows poor shielding effect.

(iii) 4*d* series and other transition metals act as catalyst because they participate in various type of chemical reactions i.e.,

$$N_2 + 3H_2 \underset{\text{High temp. High pressure}}{\overset{\text{Fe/Mo}}{\rightleftharpoons}} 2NH_3$$

23. Write the IUPAC names of the following coordination compounds:

(i) $[Cr(NH_3)_3Cl_3]$

(ii) $K_3[Fe(CN)_6]$

(iii) $[CoBr_2(en)_2]^+$, **(en = ethylenediamine)** **3**

Ans. (i) Triaminetrichloridochromium (III)

(ii) Potassium hexacyanoferrate (III)

(iii) dibromobis(ethylenediamine)cobalt (III) ion

24. Give the structures of A, B and C in the following reactions:

(i) $C_6H_5N_2^+Cl^- \xrightarrow{CuCN} A \xrightarrow{H_2O/H+} B \xrightarrow[\Delta]{H_2O/H^+} C$

*** (ii)** $C_6H_5NO_2 \xrightarrow{Sn+HCl} A \xrightarrow{NaNO_2+HCl} B \xrightarrow[\Delta]{H_2O/H^+} C$

Ans. (i)

$$C_6H_5 - N_2^+ - Cl^- \xrightarrow{CuCN} C_6H_5 - CN \xrightarrow{H_2O/H^+} C_6H_5 - COOH$$

Benzoic acid

$$\xrightarrow{NH_3 - H_2O} C_6H_5 - CONH_2$$

Benzenamide

*** 25. Write the names and structures of the monomers of the following polymers:**

(i) Buna - S

(ii) Neoprene

(iii) Nylon-6, 6 **3**

26. After watching a programme on TV about the adverse effects of junk food and soft drinks on the health of school children, Sonali, a student of Class XII, discussed the issue with the school principal. Principal immediately instructed the canteen contractor to replace the fast food with the fibre and vitamins rich food like sprouts, salad, fruits etc. This decision was welcomed by the parents and the students.

After reading the above passage, answer the following questions:

(a) What values are expressed by Sonali and the Principal of the school?

(b) Give two examples of water-soluble vitamins. **3**

Ans. (a) Sonali and principal discussed about the harmful effects of fast food on the health of student. They expressed the value of healthy food because healthy food is low in carbohydrate and fat. Healthy food contain high amount of minerals and vitamins. vitamins are important for growth and over all development of the students.

(b) Vitamin B & C are water soluble
e.g. legumes, leafy vegetable and citrus.

*** 27. (a) Which one of the following is a food preservative?**

Equanil, Morphine, Sodium benzoate

(b) Why is bithional added to soap ?

(c) Which class of drugs is used in sleeping pills? **3**

28. (a) A reaction is second order in A and first order in B.

(i) Write the differential rate equation.

(ii) How is the rate affected on increasing the concentration of A three times?

(iii) How is the rate affected when the concentrations of both A and B are doubled ?

(b) A first order reaction takes 40 minutes for 30% decomposition. Calculate $t_{1/2}$ this reaction.

* *Out of Syllabus*

(Given log 1.428 = 0.1548) 5

OR

(a) For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction.

(b) Rate constant 'k' of a reaction varies with temperature 'T' according to the equation:

$$\log k = \log A - \frac{E_a}{2.303R}\left(\frac{1}{T}\right)$$

Where E_a is the activation energy. When a graph is plotted for log k Vs. $\frac{1}{T}$, a straight line with a slope of – 4250 K is obtained. Calculate 'E_a' for the reaction. (R = 8.314 JK^{-1} mol^{-1})

Ans. (a) **(i)** Differential Rate equation:

$$\frac{dx}{dt} = K[A][B]^2$$

(ii) Let [A] = a, [B] = b

if [B] increases three times

$$[B] = 3b$$

$$\therefore \quad \text{Rate} = K[A][B]^2$$

$$\text{Rate}_1 = K \times a \times b^2 \quad ...(i)$$

$$\text{Rate}_2 = K \times a \times (3b)^2 \quad ...(ii)$$

From eqn (i) and eqn (ii)

$$\frac{\text{Rate}_2}{\text{Rate}_1} = \frac{K \times a \times (3b)^2}{K \times a \times b}$$

$$\text{rate}_2 = 9 \times \text{Rate}_1$$

$\because$ The rate becomes 9 times when the concentration of B is tripled.

(iii) If [A] and [B] is doubled then [A] = 2a, [B] = 2b

$$\text{Rate}_1 = K \times a \times b^2 \quad ...(ii)$$

$$\text{Rate}_2 = K \times (2a) \times (2b)^2 \quad ...(ii)$$

From eqn (i) and eqn (ii)

$$\frac{\text{Rate}_2}{\text{Rate}_1} = \frac{K \times (2a) \times (2b)^2}{K \times a \times b^2} = 8$$

$$\text{Rate}_2 = 8 \times \text{Rate}_1$$

$\because$ The rate becomes eight times when the concentration of both A and B is doubled.

OR

(i) For the first order reaction:

$$t = \frac{2.303}{K}\log\frac{a}{a-x}$$

$$t_{99\%} = \frac{2.303}{K}\log\frac{100}{1}$$

$$= \frac{2.303}{K}\log 100$$

$$= \frac{2.303 \times 2}{K}$$

$$= \frac{4.606}{K}$$

and

$$t_{90\%} = \frac{2.303}{K}\log\frac{100}{10}$$

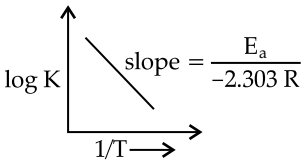
$$= \frac{2.303}{K}\log 10$$

$$= \frac{2.303}{K}$$

$\because$ $\frac{t_{99\%}}{t_{90\%}} = 2$

$$t_{99\%} = 2 \times t_{90\%}$$

(b) $$\log K = -\frac{E_a}{2.303R}\left(\frac{1}{T}\right)$$



$$-\frac{E_a}{2.303\ R} = -4250$$

$$E_a = 4250 \times 2.303 \times 8.314$$

$$= 81375\ J\ mol^{-1}$$

$$= 81.375\ kJ\ mol^{-1}$$

*** 29. (a) Give reasons for the following:**

(i) Bond enthalpy of F_2 is lower than that of Cl_2.

(ii) PH_3, has lower boiling point than NH_3.

(b) Draw the structures of the following molecules:

(i) BrF_3

(ii) $(HPO_3)_3$

(iii) XeF_4 **5**

OR

(a) Account for the following:

(i) Helium is used in diving apparatus.

(ii) Fluorine does not exhibit positive oxidation state.

(iii) Oxygen shows catenation behaviour less than sulphur.

(b) Draw the structures of the following molecules:

(i) XeF_2

(ii) $H_2S_2O_8$

30. (a) Although phenoxide ion has more number of resonating structures than carboxylate ion, Carboxylic acid is a stronger acid than phenol. Give two reasons.

(b) How will you bring about the following conversions?

(i) Propanone to propane

(ii) Benzoyl chloride to benzaldehyde

(iii) Ethanal to but-2-enal **5**

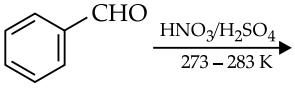
* *Out of Syllabus*

OR

(a) Complete the following reactions:

(i) $2H - \underset{\underset{O}{\|}}{C} - H \xrightarrow{\text{Conc.KOH}}$

(ii) $CH_3COOH \xrightarrow{Br_2/P}$

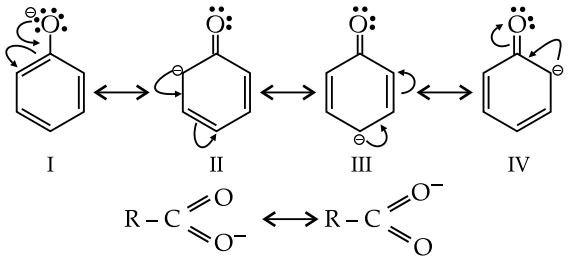
(iii) 

(b) Give simple chemical tests to distinguish between the following pairs of compounds:

(i) Ethanal and Propanal

(ii) Benzoic acid and Phenol

Ans. (a) Resonating structure of phenoxide:

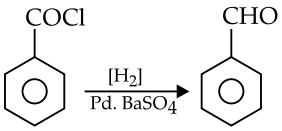


(i) In phenoxide resonating structure only I & IV carry the negative charge. So, it is negligibly contributed in the stability of phenoxide ion. Here, negative charge is present on one oxygen atom.

(ii) In carboxylate ion, negative charge delocalized on both oxygen atom which is highly electronegative and contributed more in stability of resonating structure of carboxylate ion.

(b) (i) Propanone to propane (Wolff-Kishner Reduction)

$$\begin{matrix} CH_3 \\ CH_3 \end{matrix}\!\!\diagdown\!\!\diagup C = O + 4[H] \xrightarrow[\text{Conc. HCl}]{\text{Zn(Hg)}} CH_3 - CH_2 - CH_3 + H_2O$$

(ii) 

(iii) $CH_3 - CHO \xrightarrow{OH^-} CH_3 - \underset{\underset{OH}{|}}{CH} - CH_2 - CHO \xrightarrow[H^+]{\Delta} CH_3 - CH = CH - CHO$

(aldol condensation)

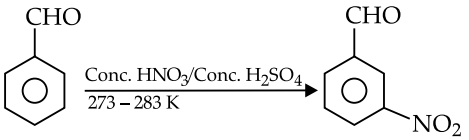
OR

(a) (i) $H - \underset{\underset{O}{\|}}{C} - H + H - \underset{\underset{O}{\|}}{C} - H \xrightarrow{\text{Conc. KOH}} H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - OH + H - \overset{\overset{O}{\|}}{C} - OK$

(Cannizaro Reaction) Ethanol Potasium formate

(ii) $CH_3 - COOH \xrightarrow{Br_2/P} Br - CH_2 - COOH$

(HVZ Reaction)

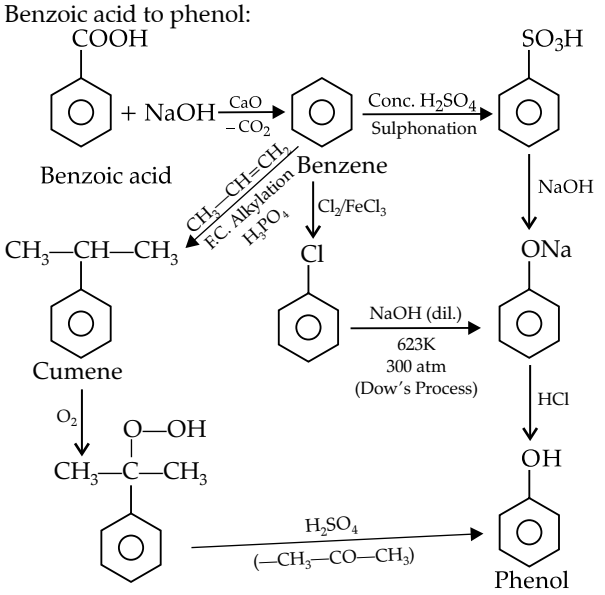
(iii) 

Benzaldehyde *m*-nitro Benzaldehyde

(b) (i) $CH_3–CHO \xrightarrow[[H_2]]{LiAlH_4} CH_3–CH_2–OH \xrightarrow[Al.KCN]{} CH_3–CH_2 \xrightarrow{H_2O/H^+}$

$CH_3–CH_2–COOH \xrightarrow{MNO_2/300°C} CH_3–CH_2–CHO$

(ii) Benzoic acid to phenol:



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