How to Get 80+ in AHSEC-2024
Lecture 9 || Pattern Classes

1. Mention a method used for desalination of sea water. 1

Reverse osmosis is used for desalination of sea water.

2. Name one vitamin which is neither soluble in water nor in fat. 1

Biotin (Vitamin H) is neither s oluble in water nor in fat.

3. Write the IUPAC name of the following - 1

$[Co(NH_3)_4Cl_2]^{\oplus}$

4. Give one example of pseudo 1st order reaction. 1

Hydrolysis of canesugar : Sucrose on reacting with excess water produces glucose and fructose which is an example of pseudo first order reaction

5. What is of primary cell? 1

A primary cell is a cell that is designed to be used once and discarded, and not recharged with electricity and reused like a secondary cell.

6. Arrange the following compounds in increasing order of their acid strength. $CH_3CH_2CH_2COOH$, $CH_3CH(Br)CH_2COOH$ 1

$CH_3CH_2CH(Br)COOH$, $(CH_3)_2CHCOOH$

$(CH_3)_2CHCOOH < CH_3CH_2CH_2COOH < CH_3CH(Br)CH_2COOH < CH_3CH_2CH(Br)COOH$

7. A Grignard reagent reacts with methanal to form $(CH_3)_2 C_2H_4O$. Identify the Grignard reagent. 1

8. Arrange the following compounds in increasing order of the boiling points: 1

CH_3CHO, CH_3CH_2OH, $CH_3CH_2CH_3$, CH_3-O-CH_3

CH3CH2CH3 < CH3OCH3 < CH3CHO < CH3CH2OH

9. Why cold water is more suitable than warm water for aquatic species? 2

The amount of dissolved oxygen in water decreases with rise in the water's temperature. Cold water has more dissolved oxygen per unit area than warm water. This the reason why aquatic animals are more comfortable in cold water than warm water.

10. Assuming complete dissociation, calculate the expected freezing point of solution prepared by dissolving 6g of $Na_2SO_4 \cdot 10H_2O$ in 0.1kg of wat

According to the relation, $DT_f = \frac{K_f}{MB} \times \frac{W_a}{W_b} \times 1000 \times i$

$= \frac{1.86}{322} \times \frac{6.0}{100} \times 1000 \times 3 = 1.039$ K

, the freezing point will be calculated as = 273 - 1.039 K = 271.96 K

11. Urea $[(NH_2)_2CO]$ forms an ideal solution in water. Calculate the vapour pressure of an aqueous solution containing 5% by mass of urea at 298K. At 298K, 2
vapour pressure of water is 23.75mn

$\chi_w = \frac{\frac{95}{18}}{\frac{1}{12} + \frac{95}{18}}$

$= 0.985$

Acc to Raoult's law

$P = P_0 \chi$

$= 23.75 \times 0.985$

$= 23.393$ mm of Hg

Pattern Classes

12. Define the term (সংজ্ঞা লিখা) -

a) Peptide linkage b) Essential amino acid

13. Name the vitamin deficiency of which causes scurvy. Name the protein which is present in hair. 1x2=2

Scurvy is a clinical syndrome resulting from vitamin C deficiency. Vitamin C is essential for the growth and repair of skin, cartilage, bone, and teeth. In addition, it has significant antioxidant properties that protect cells from free radical damage.

14. Give the general formula of carbohydrates. Why polysaccharides are called non-sugar.

The general formula for carbohydrates is Cx(H2O)y

Carbohydrates which yield a large number of monosaccharide units hydrolysis are called polysaccharides. Some common examples are Starch, Cellulose, Glycogen, Gums, etc. Polysaccharides are long chains of sugars but since they are not sweet in taste, hence they are also called non-sugars.

15. For the reaction (তলব বিক্রিয়াটোৰ বাবে), 2

$2AgCl_{(s)} + H_{2(g)}(1atm) \rightarrow 2Ag_{(s)} + 2H^{\oplus}(0.1M) + 2Cl^{\ominus}(0.1M)$

$\Delta G = -43600J$, at 298K Calculate the *emf* of the cell

(a) $2AgCl(s) + H_2(g)(1\ atm) \longrightarrow 2Ag(s) + 2H^+(0.1\ M) + 2Cl^-(0.1\ M)$

(Reduction: $2AgCl(s) \rightarrow 2Ag(s)$; Oxidation: $H_2(g) \rightarrow 2H^+$)

$\Delta G^\circ = -nFE^\circ_{cell}$

$E^\circ_{cell} = -\frac{\Delta G^\circ}{nF} = \frac{-(-43600)}{2 \times 96500} = 0.23$

$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n} \log \frac{[H^+]^2[Cl^-]^2}{1} = 0.23 - \frac{0.0591}{2} \log (10^{-1})^2 (10^{-1})^2$

$= 0.23 - \frac{0.0591}{2}(-4) = 0.23 + 0.12 = 0.35$ V

17. $Zn^{2\oplus}$ salts are colourless while $Cu^{2\oplus}$ salts are coloured. Explain. 2

Zn2+ has 3d10 configuration and no unpaired electrons, hence it is colourless. Whereas in Cu2+ state which has 3d9 configuration there is one unpaired electron and it undergoes d-d transitions emiting colour so Cu2+ salts are blue in colour.

18. Draw the facial and meridional isomer of the complex - 2

$[RhCl_2(C_5H_5N)_2]$

19. Show that $[Ni(H_2O)_6]^{2\oplus}$ is paramagnetic. 2

NH3 is a weak field ligand here. So it does not cause pairing of unpaired valence electrons of Ni, therefore, [Ni(NH3)6]2+ is paramagnetic

20. Show that, the amount of substance left after n-half life is equal to $A_0/2^n$. 2

At $t = t_{1/2}$ (1 half life) $[A] = \frac{[A]_0}{2}$

At $t = 2t_{1/2}$ (2 half life) $[A] = \frac{1}{2}\frac{[A]_0}{2} = \frac{[A]_0}{2^2}$

At $t = nt_{1/2}$ (n half life) $[A] = \frac{[A]_0}{2^n}$

21. A 1st order reaction has a rate constant of 0.0051 min^{-1}. If we begin with 0.10M concentration of the reactant, what concentration of the reactant will remain in solution after 3 hours.

According to question,

$[R]_0 = 0.10\ M, k = 0.0051\ min^{-1}, t = 3 \times 60 = 180\ min.$

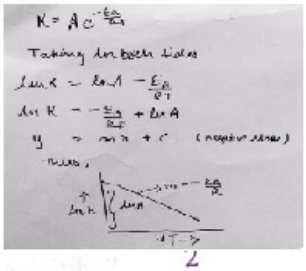
$$t = \frac{2.303}{k}\log\frac{[R]_0}{[R]}$$

$$3 \times 60\ min = \frac{2.303}{0.0051\ min^{-1}}\log\frac{0.10}{[R]}$$

$$\log\frac{0.10}{[R]} = \frac{180 \times 0.0051}{2.303}$$

$$\log\frac{0.10}{[R]} = 0.399 \qquad [R] = 0.04\ M.$$

Show the plot of lnk against $1/T$ has a slop of $-\frac{E_a}{R}$. Give the graphical representation.



2

Calculate the *emf* of the following cell at 298K.

$2Cr_{(s)} + 3Fe^{2\oplus}_{(aq)}(0.1M) \rightarrow 2Cr^{3\oplus}_{(aq)}(0.01M) + 3Fe_{(s)}$

Given (দিয়া আছে), $E^*_{Cr^{3+}/Cr} = -0.074V$

$E^*_{Fe^{2+}/Fe} = -0.44V$

The cell can be represented as follows:

$Cr|Cr^{3+}(0.01M)||Fe^{2+}(0.1M)|Fe(s)$

E^o_{Cell} can be calculated as follows:

$$E^o_{Cell} = E^o_{Fe^{2+}/Fe} - E^o_{Cr^{3+}/Cr}$$

$$E^o_{Cell} = -0.44 - (-0.74) = 0.30V$$

$$E_{Cell} = E^o_{Cell} - \frac{2.303RT}{nF}\log\left(\frac{[Cr^{3+}]^2}{[Fe^{2+}]^3}\right)$$

$$E_{Cell} = 0.30 - \frac{0.0591}{6}\log\left(\frac{(0.01)^2}{(0.1)^2}\right)$$

$E_{Cell} = 0.30 + 0.01$ $\quad E_{Cell} = 0.31$ V

(ii) In the titration of $FeSO_4$ with $KMnO_4$ in acidic medium dil. HCl is not used - why?

b) (i) Cu (I) has d^{10} configuration, while Cu (II) has d^9 configuration. Still Cu (II) is more stable in aqueous solution than Cu (I). Why?

Copper(I) has d10 configuration, while copper(II) has d9 configuration, still copper(II) is more stable in aqueous solution than copper(I) due to more negative enthalpy of hydration of Cu(aq)2+ than Cu(aq)+ which compensates for second ionisation enthalpy of copper.

ii) Which is a stronger oxidising agent between Bi (V) and Sb (V) - Give reason.

Bi has +5 oxidation state and it is a stronger oxidizing agent than Sb because Bi gains electrons from the reducing agent very much faster than the Sb and becomes stable from +5 oxidation state to +3 oxidation state.

27. i) Alkenes and carbonyl compounds, both contain a π bond but alkenes show electrophilic addition reactions whereas carbonyl compounds show nucleophilic addition reactions - Explain why. 1

Alkenes are electron rich species, because of that they generally show electrophilic addition reaction. While, In (>C=0) (Carbonyl). There is a electron deficiency at carbonyl carbon due to the presence of highly electronegative oxygen atom. Because of that carbonyls behave as a electrophilic and show nucleophilic addition reactionsRead more on Sarthaks.com - https://www.sarthaks.com/2869675/alkenes-c-c-and-carbonyl-compounds-c-0-both-contain-a-bond-but-alkenes-show-electrophilic

ii) Identify the product (বিক্রিয়াজাত পদার্থ চিনাক্ত করা) : 1

$$CH_3-C-CH_3 \xrightarrow[ii)\ KOH/Cr_2O_3/\Delta]{i)\ H_2N-NH_2} \longrightarrow$$

28. Although phenoxide ion has more number of resonating structures that carboxylate ion, carboxylic acid is a stronger acid than phenol. Why? 2

The resonating structures of carboxylate ion contribute more towards its stability than those of phenoxide ion. As a result, carboxylate ion is more resonance-stabilized than phenoxide ion. Hence, carboxylic acid is stronger acid than phenol.

29. Write the mechanism of the following reaction. 2

$$(CH_3)_3C-OH \xrightarrow{HBr} (CH_3)_3C-Br + H_2O$$

30. i) Arrange the following compounds in increasing order of reactivity towards Lucas reagent. 1

$(CH_3)_3C-OH,\ CH_3CH_2OH,\ CH_3CH(OH)CH_3$

Lucas reagent — Anhyd $ZnCl_2$ + conc. HCl

1°, 2°, 3° alcohol distinguish

1° alc. —Lucas reagent→ ppt. is formed by 10 min

2° alc. —" → " " " by 5-10 "

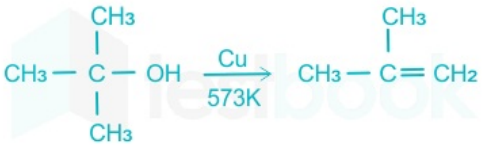
3° alc. —" → " " " immediately

$CH_3CH_2OH < CH_3-\underset{H}{\overset{OH}{C}}-CH_3 < H_3C-\underset{CH_3}{\overset{CH_3}{C}}-OH$

1° < 2° < 3°

Or/অথবা

What happens when vapour of 3° alcohol is passed over heated copper at 537K?



- The product formed is **2-Methyl propene**.

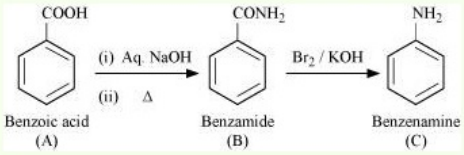
31. An aromatic compound 'A' on treatment will aqueous ammonia & heating forms compound 'B' which on heating with Br_2 & KOH forms a compound 'C' of molecular formula C_6H_7N. Write the structures, IUPAC names of the compounds A, B, C & give the chemical reactions involved. 2

It is given that compound 'C' having the molecular formula, C6H7N is formed by heating compound 'B' with Br2 and KOH. This is a Hoffmann bromamide degradation reaction. Therefore, compound 'B' is an amide and compound 'C' is an amine. The only amine having the molecular formula, C6H7N is aniline, (C6H5NH2).

Therefore, compound 'B' (from which 'C' is formed) must be benzamide, (C6H5CONH2).

Further, benzamide is formed by heating compound 'A' with aqueous ammonia. Therefore, compound 'A' must be benzoic acid.

The given reactions can be explained with the help of the following equations:



32. Account for the following. 2

i) Methylamine in water reacts with ferric chloride to precipitate hydrated ferric oxide.

Methylamine in water reacts with ferric chloride to precipitate hydrated ferric oxide: Due to the +I effect of −CH3 group, methylamine is more basic than water. Therefore, in water, methylamine produces OH− ions by accepting H+ ions from water. Ferric chloride (FeCl3) dissociates in water to form Fe3+ and Cl− ions. $2Fe^{3+} + 6OH^- \rightarrow Fe_2O_3.3H_2O$

ii) Aromatic amines are weaker bases than aliphatic amines.

In aromatic amines, the −NH2 group is attached to a −C6H5 group, which is an electron withdrawing group. So, the availability of a lone pair of electrons on N is decreased. Therefore aliphatic amines are more basic than aromatic amines.

33. Give chemical test to distinguish between the following pairs of compounds. i) Ethylamine and aniline 2

When aromatic amines react with nitrous acid at low temperature, diazonium salt is formed. Then coupling the diazonium salt with 2-naphthol in presence of base such as aqueous sodium hydroxide solution. We will get a bright coloured azo dye. But if we add nitrous acid to aliphatic amines, then effervescence of nitrogen gas is obtained.
Thus, we can distinguish between ethylamine and aniline by using azo dye test.

ii) Dimethylamine and Triethylamine

Diethylamine reacts with nitrous acid to form N-nitrosoamine which is water insoluble yellow oil while triethylamine reacts with nitrous acid to form soluble nitrite salt. There is no visible sign of reaction. Diethylamine reacts with benzene sulphonyl chloride and forms a solid insoluble in alkali. Tertiary amine (triethyl amine) does not react with benzene sulphonyl chloride.

34. How does the acidified permanganate solution react with the following? 3

i) KI ii) Iron (II) ion iii) Oxilic acid

i. Acidified permanganate solution oxidizes iron (II) salt to iron (III) salts.
MnO4- + 8H+ + 5Fe2+ → Mn2+ + 4H2O + 5Fe3+

ii. It oxidizes sulphur dioxide to sulphuric acid. 2MnO4- 5SO2 + 2H2O → 5SO42- + 2Mn2+ + 4H+

iii. It oxidizes oxalic acid to CO2 and H2O. 2MnO4- + 16H+ + 5C2O42- → 2Mn2+ + 8H2O + 10CO2.

i) Why are powdered substances are more effective adsorbents than their crystalline forms?

Ans. : Powdered substances are more effective adsorbents than their crystalline forms because when a substance is powdered, its surface area increases and physisorption is directly proportional to the surface area of the adsorbent.

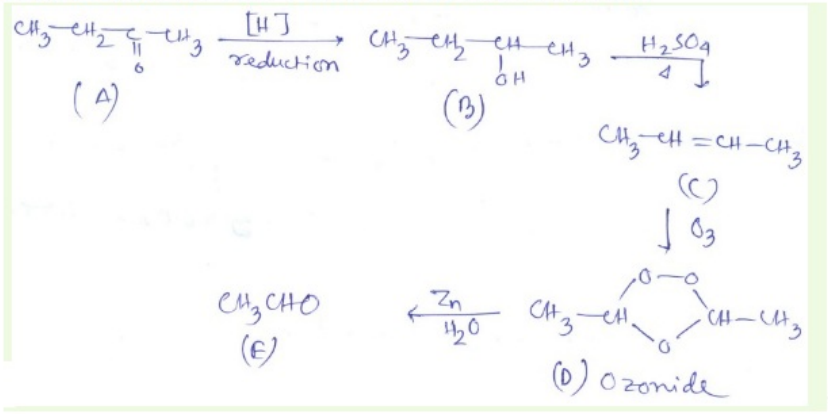
ii) In the first transition series of elements, which element shows highest oxidation state & what?

Ans. : Mn shows +7 highest oxidation state

iii) The transition metal compounds are good catalyst - Give reason.

Transition metals have partially filled d- orbitals so they can easily withdraw the electrons from the reagents or give electrons to them depending on the nature of the reaction. They also have a tendency to show large no. of oxidation states and the ability to form complexes which makes them a good catalyst.

36. A ketone A (C4H8O), which undergoes haloform reaction gives compound B on reduction. B on heating with sulphuric acid gives a compound C which forms mono-ozonide D. D on hydrolysis in presence of zinc dust gives only acetaldehyde E. Identify A, B, C, D and E. Write the reactions involved.



36. Give any one reaction of Swartz, Wurtz and Finkelstein reaction of alkyl halides.

Solution

Swarts reaction : It is one of the best rxn. to produce fluoroalkane. When alkyl chloride / alkyl bromide is heated in presence of metallic fluoride (such as AgF, Hg_2F_2, CoF_2 etc), alkyl fluoride is produced

ex. $CH_3CH_2Cl + AgF \rightarrow CH_3CH_2F + AgCl$

The Wurtz reaction, is a coupling reaction whereby two alkyl halides are reacted with sodium metal in dry ether solution to form a higher alkane

$CH_3CH_2Cl + Na(\text{dry ether}) \rightarrow CH_3CH_2CH_2CH_3 + NaCl$

Finkelstein reaction is the treatment of a primary alkyl halide with an alkali metal iodide (e.g. KI) that leads to replacement of the halogen via an SN2 Reaction with I

$CH_3CH_2Cl + KI \rightarrow CH_3CH_2I + KCl$