B K BIRLA CENTRE FOR EDUCATION
SARALA BIRLA GROUP OF SCHOOLS
SENIOR SECONDARY CO-ED DAY CUM BOYS' RESIDENTIAL SCHOOL
PRE BOARD - II (2024-25)
CHEMISTRY (043)
MARKING SCHEME

CLASS: XII TIME: 3 hrs

1.

    (b) 3-oxobutanal

    Explanation:

    3-oxobutanal

2.

    (d) hydrogen bonds

    Explanation:

    α-helix structure of the protein is stabilized by hydrogen bonds. A polypeptide chain forms all possible hydrogen bonds by twisting into a right-handed screw helix with the -NH group of each amino acid residue hydrogen-bonded to $> C = O$ of an adjacent turn of the helix.

3.

    (d) $+ CH_3 - I$

    Explanation:

    When anisole (phenyl methyl ether) reacts with hydrogen iodide (HI), it produces phenol and methyl iodide
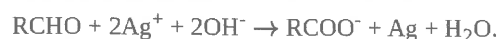
4.

    (b) Tollen's reagent

    Explanation:

    Tollen's Test is used to distinguish between aldehyde and ketone. It uses the fact that aldehydes are easily oxidised to their corresponding acids while ketones are not.

    Tollen's reagent is aqueous ammonical silver nitrate solution which reacts with aldehydes as shown.

    $RCHO + 2Ag^+ + 2OH^- \rightarrow RCOO^- + Ag + H_2O$.

    $RCOR + 2Ag^+ + 2OH \rightarrow$ No reaction

    If this test is carried in a glass tube, the Ag formed forms a mirror on the sides of the test tube so the test is also known as the silver mirror test.

    Aldehydes show Tollen's test while acetone which is a ketone does not give Tollen's test.

5.   **(a)** 2.31×10^{-3} min^{-1}

    Explanation:

    K=0.693

    $t_{1/2}=0.693/30 = 2.31 \times 10^{-3}$ min^{-1}

6.   **(a)** (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)
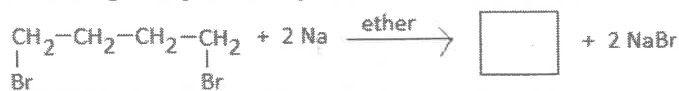
    Explanation:

    (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

7.

    (d) 1, 4 – dibromobutane

    Explanation:

Of all the given options, it is possible with 1,4-dibromobutane to form cyclobutane as shown by intramolecular wurtz reaction.

$$\underset{\substack{| \\ Br}}{CH_2}-CH_2-CH_2-\underset{\substack{| \\ Br}}{CH_2} + 2\ Na \xrightarrow{\text{ether}} \boxed{} + 2\ NaBr$$

1,4 dibromobutane   Cyclobutane

8.

(c) Variable oxidation states

Explanation: Variable oxidation states

9.

(b) $\dfrac{d[NH_3]}{dt} = -\dfrac{2}{3}\dfrac{d[H_2]}{dt}$

Explanation:

For the given reaction,

$$rate = -\frac{1}{2}\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$$
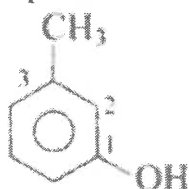
10.

(c) HCHO

Explanation:

Those aldehydes which do not have α-hydrogen atom like HCHO, does not give alcohol condensation reaction.

11.

(d) 3-methylphenol

Explanation:

-OH is a functional group and -CH_3 is the substituent.

We start numbering from the side of the main functional group -OH.

IUPAC name: 3-methyl phenol

12.

(b) CH_3NH_2

Explanation:

Aliphatic primary amines react with nitrous acid (prepared in situ from $NaNO_2$ and a mineral acid such as HCl) to form aliphatic diazonium salts, which is unstable and decomposes to give a carbocation and evolve N_2 gas. The carbocation so formed reacts with water from medium to give further produce alcohol.

13.

(c) A is true but R is false.

Explanation:

Maltose, a disaccharide ($C_{12}H_{22}O_{11}$) is a reducing sugar, which upon hydrolysis yields 2 moles of D (+) glucose. In it, the two D-glucose units are linked through the α-glycosidic linkage between C-1 of one glucose unit and C-4 of the other.

14.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation:

HCHO cannot be prepared by Rosenmund's reduction because formyl chloride is unstable at room temperature.

15.

    (c) A is true but R is false.

    Explanation:

    A is true but R is false.

16.   **(a)** Both A and R are true and R is the correct explanation of A.

    Explanation:

    Both A and R are true and R is the correct explanation of A.

Section B

17. In both the complexes, Fe is in +2 state with the configuration $3d^6$, i.e. it has four unpaired electrons. As H_2O and CN^- possess different crystal field splitting energy (Δ_o), they absorb different components of visible light (VIBGYOR) for d- d transition. Hence, the transmitted colours are different.

18. The chromates and dichromates are interconvertible in aqueous solution depending upon pH of the solution.

$$2\,CrO_4{}^{2-} + 2H^+ \rightarrow Cr_2O_7{}^{2-} + H_2O.$$

$$Cr_2O_7{}^{2-} + 2\,OH^- \rightarrow 2\,CrO_4{}^{2-} + H_2O.$$
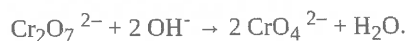
On increasing pH of dichromate solution, yellow colour dichromate solution converts to green colour chromate.

19. Answer the following:

    (i) $Y = 2X$.

    (ii) $\log k = \log A - \dfrac{E_a}{2\cdot303RT}$

$$-\frac{E_a}{2\cdot303R} = -2 \times 10^4 \text{ K}$$

$$E_a = 2.303 \times 8.314 \text{ J K}^{-1}\text{ mol}^{-1} \times 2 \times 10^4 \text{ K}$$

$$E_a = 3.830 \times 10^5 \text{ J mol}^{-1}$$

20. According to Raoult's law

$$\frac{p^\circ - p}{p^\circ} = X_B = \frac{n_B}{n_A + n_B}$$
$$= \frac{n_B}{n_A} = \frac{w_B \times M_A}{M_B \times w_A}$$

(for dilute solution, $n_B <<< n_A$)

Molar mass of the solute M_B is given as

$$M_B = \frac{w_B \times M_A}{w_A} \cdot \frac{p^\circ}{p^\circ - p}$$

W_B= mass of the solute = 0.2g

M_A= molar mass of water = 18g/mol

W_A= mass of water = 100-0.2 = 99.8g
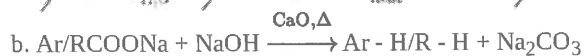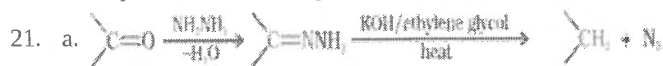
p^0= Vapour pressure of water =1.013bar

P= vapour pressure of solution = 1.004bar

$$= \frac{0.2 \times 18}{99.8} \times \frac{1.013}{1.013 - 1.004}$$

$$= 4.06\text{g mol}^{-1}$$

OR

The solutions (liquid mixtures) which boil at constant temperature and remains unchanged in composition are called azeotropes or azeotropic mixtures. Example: ethanol and water

21. a. $\ce{>C=O ->[NH_2NH_2][-H_2O] >C=NNH_2 ->[KOH/ethylene\ glycol][heat] >CH_2 + N_2}$

    b. $Ar/RCOONa + NaOH \xrightarrow{CaO,\Delta} Ar - H/R - H + Na_2CO_3$

    c. $2HCHO \xrightarrow[\Delta]{\text{Conc. NaOH}} HCOO^-Na^+ + CH_3OH$

Section C

22. It is used as reference electrode. Its electrode potential is taken as 0.00 volt. Hydrogen electrode consists of platinum wire coated with finely divided platinum black containing pure hydrogen gas at 1 atm and solution of HCl (1 M) so as to maintain equilibrium between H^+ ions and $H_2(g)$.

At cathode

$$2H^+ + 2e \rightarrow H_2$$

At anode

$$H_2 \rightarrow 2H^{2+} + 2e^-$$

significance: In the measurement of electrode potential.

23. The decomposition of on platinum surface is represented by the following equation.

$$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$$

Therefore, $Rate = -\frac{1}{2}\frac{d[NH_3]}{dt} = \frac{d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt}$

However, it is given that the reaction is of zero order.

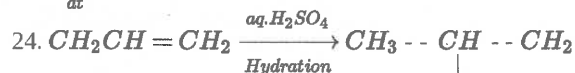$-\frac{1}{2}\frac{d[NH_3]}{dt} = \frac{d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt} = k$

Therefore, $k = 2.5 \times 10^{-4} mol\, L^{-1} s^{-1}$

Hence, the rate of production of N_2 is

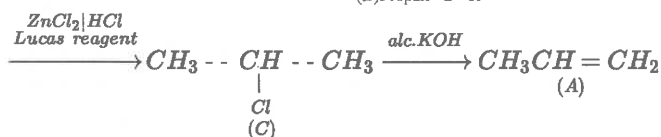$\frac{d[N_2]}{dt} = 2.5 \times 10^{-4} mol\, L^{-1} s^{-1}$

And, the rate of production of H_2 is

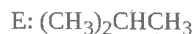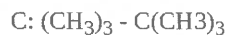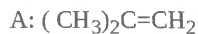$\frac{d[H_2]}{dt} = 3 \times 2.5 \times 10^{-4} mol\, L^{-1} s^{-1} = 7.5 \times 10^{-4} mol\, L^{-1} s^{-1}$

24. $CH_2 CH = CH_2 \xrightarrow[Hydration]{aq.H_2SO_4} CH_3 - - CH - - CH_2$
    $\qquad\qquad\qquad\qquad\qquad\qquad\quad |$
    $\qquad\qquad\qquad\qquad\qquad\qquad\quad OH$
    $\qquad\qquad\qquad\qquad\qquad\qquad$ (B)Propan - 2 - ol

$\xrightarrow[\text{Lucas reagent}]{ZnCl_2|HCl} CH_3 - - CH - - CH_3 \xrightarrow{alc.KOH} CH_3 CH = CH_2$
$\qquad\qquad\qquad\qquad\quad\;\; | \qquad\qquad\qquad\qquad\quad (A)$
$\qquad\qquad\qquad\qquad\quad\;\; Cl$
$\qquad\qquad\qquad\qquad\quad\;\; (C)$

OR

A: $(CH_3)_2C=CH_2$

B: $(CH_3)_2CBrCH_3$

C: $(CH_3)_3 - C(CH3)_3$
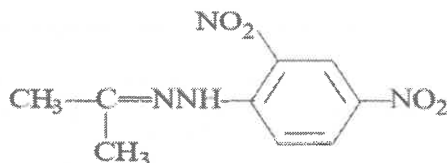
D: $(CH_3)_2CHCH_2MgBr$

E: $(CH_3)_2CHCH_3$

F: $(CH_3)_2 CHCH_2OC_2H_5$
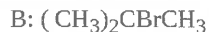
25. i. Because of oxidation of propanal involves cleavage of C-H bond which is weaker than C-C bond of propanone.

ii. On heating with NaOH and I_2, acetophenone gives yellow precipitate of iodoform whereas benzophenone does not.

iii.

26. $E_{cell} = E^0_{cell} - \frac{0.059}{6}\log\frac{[Cr^{3+}]^2}{[Fe^{2+}]^3}$

$E^0_{cell} = -0.45 - (-0.75)$

$= 0.30$ V

$E_{cell} = 0.3 - \frac{0.059}{6}\log\frac{(0-1)^2}{(0.01)^3}$

$= 0 \cdot 3 - .00985\log\frac{(10^{-1})^2}{(10^{-2})^3}$

$= 0.3 - .00985 \times 4\log 10$

$= 0.3 - 0.0394$

$= 0.2606$ V

27. Alkyl halides can undergo both beta-elimination as well as nucleophilic substitution reactions, the desired product can be obtained using an appropriate reagent and environmental conditions of the system. Consider the case of CH_3CH_2Br, which can undergo β-elimination as well as nucleophilic substitution reaction. On treatment with alcoholic KOH, at 473-523°K, ethyl bromide undergoes elimination to give ethane(C_2H_4). On the other hand, treatment with aqueous KOH at a lower temperature of 373°K

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gives ethyl alcohol(C_2H_5OH) by a nucleophilic substitution reaction.

$$CH_3CH_2Br + alc.\,KOH \xrightarrow{473-523°K} CH_2 = CH_2 + HBr$$

$$CH_3CH_2Br + aq.\,KOH \xrightarrow{373°K} CH_3CH_2OH + KBr$$
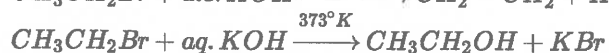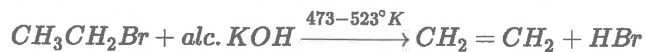
28. The given cell is , Ag (s) | $\overset{*}{Ag}{}^+(10^{-3}M)$ ‖ $Cu^{2+}(10^{-1}\,M)$ | Cu(s)

    At anode Ag(s) → Ag$^+$ (aq) + e$^-$] × 2

    At cathode, Cu^{2+} +2e$^-$ → Cu (s)

    Overall reaction; 2Ag(s) + Cu^{2+} (aq) → 2Ag$^+$ + Cu(s)

    Now, applying Nernst equation, $E_{cell} = E°_{cell} - \dfrac{0.0591}{2}\log\dfrac{[Ag^{2+}]}{[Cu^{2+}]}$ = 0.46 - $\dfrac{0.0591}{2}\log\dfrac{(10^{-3})^2}{10^{-1}}$ = 0.46 - $\dfrac{0.0591}{2}\log 10^{-5}$

    Therefore, E_{cell} = 0.608 V

Section D

29. a. Cu has incomplete d-orbital in +2 oxidation state whereas Zn has fully filled d-orbital in ground state as well as in +2 oxidation state.

    b. Because both (n-1)d and ns subshell electrons take part in the bond formation due to their comparable energies/ due to the presence of unpaired electrons in d-orbitals.

    c.   i. Because of irregular values of $(\Delta_i H_1 + \Delta_i H_2)$ and sublimation enthalpies.

        ii. In transition metals, oxidation states differ by +1 whereas in non-transition metals differ by +2.

    OR

        i. Because Cr^{2+} will be converted to Cr^{3+} which has more stable half filled t_{2g} configuration while Mn^{3+} changes to Mn^{2+} which has more stable half-filled d^5 configuration.

        ii. $2MnO_4^- + H_2O + I^- \longrightarrow 2\,MnO_2 + 2\,OH^- + IO_3^-$

30.   i. A plant cell gets shrink when it is kept in a hypertonic solution.

      ii. 1.2% sodium chloride solution is hypertonic with respect to 0.9% sodium chloride solution or blood cells. When blood cells are placed in this solution, water flows out of the cells and they shrink due to loss of water by osmosis.

     iii. When the external pressure applied becomes more than the osmotic pressure of the solution, then the solvent molecules from the solution pass through the semipermeable membrane to the solvent side. This process is called reverse osmosis.

     OR

     In an upward direction, osmosis helps in the transportation of water in a plant.

Section E

31. Attempt any five of the following:

    (i) **Pyrimidines:** These are three bases derived from pyrimidines. These are cytosine (C), thymine (T) and uracil (U).In DNA, T is present but in RNA, U is present.

       Purines: There are two bases derived from purine. These are adenine (A) and guanine (G).

       In DNA, Purines present are Adenine (A) and Guanine (G) and Pyrimidines present are Cytosine (C) and Thymine (T) while in RNA, Purines are the same while Pyrimidines present in RNA includes Cytosine (C) and Uracil (U).

    (ii)

DNA	RNA
Double stranded	Single stranded
Thymine base is present	Uracil base is present

    (iii)Glycosidic linkage

    (iv)   i. Adenine, Guanine

         ii.   1. Vitamin D

              2. Vitamin B_{12}

    (v) A starch has two components: amylose and amylopectin. Amylose is water soluble.

    (vi)In the helical structure of DNA, the two strands are held together by hydrogen bonds between specific pairs of bases. Cytosine forms hydrogen bond with guanine, while adenine forms hydrogen bond with thymine. As a result, the two strands are complementary to each other.

    (vii) i. Due to the presence of both acidic (-COOH) and basic (-NH$_2$) groups in the same molecule/they form zwitter ion which react with both acid and base.

ii.

$$\underset{\underset{CH_2OH}{|}}{\overset{\overset{CHO}{|}}{(CHOH)_4}} \xrightarrow{NH_2OH} \underset{\underset{CH_2OH}{|}}{\overset{\overset{CH=N-OH}{|}}{CHOH_4}}$$ /Glucose oxime is formed.
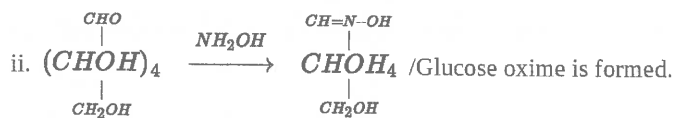
32. In both $[Fe(H_2O)_6]^{3+}$ and $[Fe(CN)_6]^{3+}$, Fe exists in the +3 oxidation state i.e., in d^5 configuration.

d | ↑ | ↑ | ↑ | ↑ | ↑ |

Since CN^- is a strong field ligand, it causes the pairing of unpaired electrons. Therefore, there is only one unpaired electron left in the d-orbital.

| ↑↓ | ↑↓ | ↑ | | | |

Therefore,

$$\mu = \sqrt{n(n+2)} = \sqrt{1(1+2)} = \sqrt{3} = 1.732\ \text{BM}$$

On the other hand, H_2O is a weak field ligand. Therefore, it cannot cause the pairing of electrons. This means that the number of unpaired electrons is 5. Therefore,

$$\mu = \sqrt{n(n+2)} = \sqrt{5(5+2)} = \sqrt{35} = 6\ \text{BM}$$

Thus, it is evident that Thus, it is evident that $[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic, while $[Fe(CN)_6]^{3+}$ is weakly paramagnetic.

OR

Coordination entity: This entity usually constitutes a central metal atom or ion, to which are attached a fixed number of other atoms or ions or groups by coordinate bonds. Examples are $[Ni(CO)_4]$, $[COCl_3(NH_3)_3]$, etc.

Ligands: It is an ion having at least one lone pair of electrons and capable of forming a coordinate bond with central atom / ion in the coordination entity.

Examples are : Cl^-, $(OH)^-$, $(CN)^-$ etc.

Coordinate number: The total number of coordinate bonds with which central atom/ ion is linked to ligands in the coordination entity is called coordination number of central atom / ion.

Coordination polyhedron : The spatial arrangement of the ligands which are directly attached to the central atom / ion defines a coordination polyhedron about the central atom.

Examples are: $[Co(NH_3)_6]^{3+}$ is octahedral,

$[Ni(CO)_4]$ is tetrahedral.

Homoleptic and hedroleptic: Complexes in which a metal is bound to only one kind of donor groups are known as homoleptic. Example $[CO(NH_3)_6]^{3+}$

Complex in which a metal is bound to more than one kind of donor groups are called hetroleptic. Example : $[Co(NH_3)_4Cl_2]^+$

33. i.

$$\underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow{SOCl_2} CH_3COCl \xrightarrow{NH_3(\text{excess})} CH_3CONH_2 \xrightarrow{Br_2/NaOH} \underset{\text{Methanamine}}{CH_3NH_2}$$

ii.

$$\underset{\text{Hexanenitrile}}{C_5H_{11}CN} \xrightarrow{H^+/H_2O} C_5H_{11}-COOH \xrightarrow{SOCl_2} C_5H_{11}-COCl \xrightarrow{NH_3(\text{excess})} C_5H_{11}-CONH_2 \xrightarrow{Br_2/KOH} \underset{\text{1-Aminopentane}}{C_5H_{11}-NH_2}$$

iii.

$$\underset{\text{Methanol}}{CH_3OH} \xrightarrow{PCl_5} CH_3Cl \xrightarrow{\text{Ethanolic NaCN}} CH_3CN \xrightarrow{H^+/H_2O} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

iv.

$$CH_3 - CH_2 - NH_2 \xrightarrow{NaNO_2/HCl} [CH_3 - CH_2 - \overset{+}{N_2}\overset{-}{Cl}] \xrightarrow{H_2O} CH_3 - CH_2 - OH$$

Ethanamine

$$\downarrow KMnO_4/H^+$$

$$CH_3 - NH_2 \xleftarrow{Br_2/NaOH} CH_3CONH_2 \xleftarrow[\Delta]{NH_3 \text{ (excess)}} CH_3COOH$$

Methanamine

v.

$$CH_3COOH \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) LiAlH}_4/\text{ether}} CH_3CH_2OH \xrightarrow{PCl_5} CH_3CH_2Cl$$

Ethanoic acid

$$\downarrow \begin{array}{c} \text{Ethanolic} \\ \text{NaCN} \end{array}$$

$$CH_3CH_2COOH \xleftarrow{H^+/H_2O} CH_3CH_2CN$$

Propanoic acid

OR

i. $C_6H_5 \overset{+}{N_2} \overset{-}{Cl} + C_6H_5NH_2 \xrightarrow{H^+} C_6H_5N = N - C_6H_5NH_2 + Cl^- + H_2O$

ii. $C_6H_5 \overset{+}{N_2} \overset{-}{Cl} + CH_3CH_2OH \rightarrow C_6H_6 + N_2 + HCl + CH_3CHO$

iii. $RNH_2 + CHCl_3 + 3KOH(alc) \xrightarrow{Heat} \underset{\text{Alkylisocyanide}}{RC \equiv N} + 3KCl + H_2O$

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