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INDIAN ASSOCIATION OF CHEMISTRY TEACHERS

NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) 2015-16

Examination Date : 22-11-2015 **Time: 2 Hrs.** **Max. Marks :240**

PAPER CODE : C252 HBCSE Olympiad (STAGE - 1)

Write the question paper code mentioned above on YOUR answer sheet (in the space provided), otherwise your answer sheet will NOT be assessed. Note that the same Q. P. Code appears on each page of the question paper.

INSTRUCTION TO CANDIDATES

1. Use of mobile phones, smart phones, ip ads during examination is STRICTLY PROHIBITED.
2. In addition to this question paper, you are given answer sheet along with Candidate's copy.
3. On the answer sheet, fill up all the entries carefully in the space provided, **ONLY In BLOCK CAPITALS**. Use only **BLUE or BACK BALL PEN** for making entries and marking answer.
   Incomplete / incorrect / carelessly filled information may disqualify your candidature.
4. On the answer sheet, use only BLUE or BLACK BALL POINT PEN for making entries and filling the bubbles.
5. The question paper contain 80 multiple-choice question. Each question has 4 options, out of which only one is correct. Choose the correct alternative and fill the appropriate bubble, as shown

   Q. No. 22 (a) ● (c) (d)

6. A correct answer carries 3 marks and 1 mark will be deducted for each wrong answer.
7. Any rough work should be done only in the space provided.
8. Periodic Table is provided at the end of the question paper.
9. Use of a nonprogrammable calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting your answer paper, take away the Candidate's copy for your reference.
    Please DO NOT make any mar other than filling the appropriate bubbles properly in the space provided on the answer sheet. Answer sheet are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED.
    Scratching or overwriting may result in wrong score.
    DO NOT WRITE ANYTHING ON THE BACK OF ANSWER SHEET.

Read the following instructions after submitting the answer sheet.

12. Comment regarding this question paper, if any, may be sent by email only to iaptpune@gmail.com till **25th November 2014.**
13. The answers/solutions to this question paper will be available on our website www.iapt.org.in by **3rd December, 2014.**
14. **Certificates & Awards**
    Following certificates are awarded by the IAPT to students successful in NSEs
    (i) Certificates to "Centre Top" 10% students
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    (iii) Merit certificate and a prize in term to "National wise" Top 1% students.
15. Result sheet and the "Centre Top 10%" certificates will be dispatched to the Prof-in-charge of the centre by **January, 2015.**
16. List of students (with center number and roll number only) having score above MAS will be display on our website (www.iapt.org.in) by **22nd December, 2014**. See the **Eligibility Clause** in the Student's brochure on our website.
17. Students eligible for the INO Examination on the basis of selection criteria mentioned in Student's brochure will be informed accordingly.
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1. A bottle of H_3PO_4 solution contains 70% acid. If the density of the solution is 1.54 g cm^{-3}, the volume of the H_3PO_4 solution required to prepare 1L of IN solution is.

(A) 90mL (B) 45mL (C) 30mL (D) 23mL

Sol. **(C)**

70% W/W H_3PO_4

70g H_3PO_4 in 100g / cm^3

P = 1.5 g/ cm^3

for IN, IL SOl^n

Eq of H_3PO_4= 1

Eq of H_3PO_4= 1 moles of H_3PO_4 x Moles of H_3PO_4

$\left[\frac{Number\ of\ moles}{valency}\right] = \frac{N \times V}{3}$ = (1/3)

Mass of H_3PO_4 = $\left(\frac{1}{3} \times 98\right)g$

70 g in 100 g sol^n

1…….. $\frac{100}{70}$

$\frac{98}{3}g$ ……= $\frac{140}{3}g$

Volume of sol^n = $\frac{m}{p}$

= $\left(\frac{140}{3 \times 1.54}\right)$ = 30mL

2. Wood or cattle dung ash is used for cleaning cooking utensils in many parts of India. The statement that is not true for this ash is :

(A) It largely consists of metal oxides and silicates because non-metals are removed as gaseous compounds during of the wood/ dung cakes

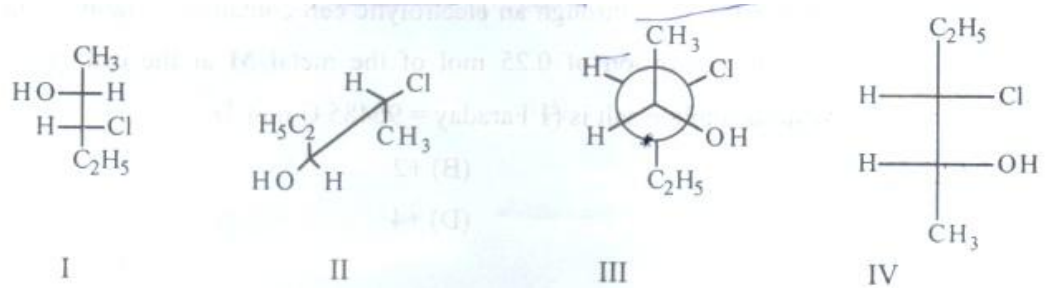
(B) When added to water, it forms alkaline solution with pH~8 and above, which helps to remove oily substances from the utensils.

(C) Several chemical components of ash remain undissolved as solids in water and these solids help in cleaning by providing scrubbing action.

(D) If left moist for a few hours in air, it slowly turns acidic because of oxidative decomposition

Sol. **(D)**

3. The two projection formulae that represent a pair of enantiomers are



(A) I and II (B) III and IV (C) I and III (D) II and IV

Sol. **(C)**

(I) have (R,R) configuration and (III) have (S,S) configuration.

4. When 1L of 0.1 M sulphuric acid solution is allowed to react with 1L of 0.1 M sodium hydroxide solution, the amount of sodium sulphate (anhydrous) that can be obtained from the solution formed and the concentration of H^+ in the solution respectively are

(A) 3.55 g, 0.1 M (B) 7.10 g, 0.025M (C) 3.55g, 0.025M. (D) 7.10g, 0.05 M

Sol. **(D)**

$$H_2SO_4 + 2NaOH \rightarrow NaSO_4 + 2H_2O$$

Initials moles	0.1	0.1	0	0
Final moles	0.1 – 0.1/2	0	0.1/2	

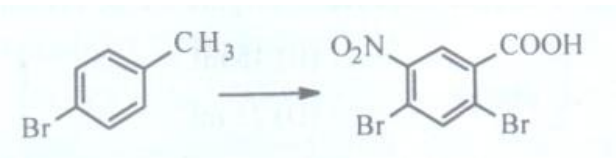
Moles of Na_2SO_4 = $\frac{0.1}{2}$

Mass of Na_2SO_4 = $\frac{0.1}{2}$ (46+96) = 0.1(23+48) = 7.1 g

Moles of Na_2SO_4 remained = $\left(\frac{0.1}{2}\right)$ = .05 Volume of Sol = 2L

$[H^+] = \frac{2\left(\frac{0.1}{2}\right)}{2} = 0.05m$

5. The best sequence of reactions for the following conversion is



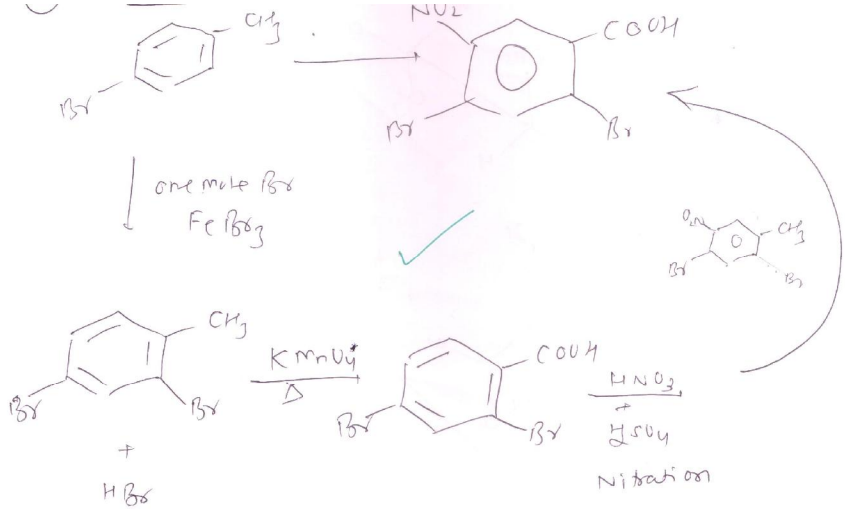
(A) (i) 1 mol Br_2 / $FeBr_3$ (ii) $KMnO_4$, heat (iii) HNO_3+H_2SO_4

(B) (i) HNO_3+H_2SO_4 (ii) 1 mol Br_2 / $FeBr_3$ (iii) $KMnO_4$, heat

(C) (i) $KMnO_4$, heat (ii) HNO_3+H_2SO_4 (iii) 1 mol Br_2 / $FeBr_3$

(D) (i) 1 mol Br_2 / $FeBr_3$ (ii) HNO_3+H_2SO_4 (iii) $KMnO_4$, heat

Sol. **(A)**



6. If λ_0 and λ are the threshold wavelength and the wavelength of the incident light, respectibvely on a metal surface, the velocity of the photoelectron ejected from the metal surface is (m_e = mass of electron, h = Planck's constant, c = speed of light)

(A) $\sqrt{\frac{2h(\lambda_0-\lambda)}{m_e}}$ (B) $\sqrt{\frac{2hc(\lambda_0-\lambda)}{m_e}}$ (C) $\sqrt{\frac{2hc}{m_e}\left(\frac{\lambda_0-\lambda}{\lambda\lambda_0}\right)}$ (D) $\sqrt{\frac{2h}{m_e}\left(\frac{1}{\lambda_0}-\frac{1}{\lambda}\right)}$

Sol. **(C)**

$$hc - hc_0 = K.E$$

$$h\frac{c}{\lambda} - \frac{hc}{\lambda_0} = K.E$$

$$hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right) = K.E = \frac{1}{2}mev^2$$

V = $\sqrt{\frac{2hc}{m_e}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)} = \sqrt{\frac{2hc}{m_e}\left(\frac{\lambda_0-\lambda}{\lambda\lambda_0}\right)}$

7. A current of 5.0 A flows for 4.0 h through an electrolytic cell containing a molten salt of metal M. This results in deposition of 0.25 mol of the metal M at the cathode. The oxidation state of M in the molten salt is (1 Faraday = 96485 C mol^{-1})

(A) +1 (B) +2 (C) +3 (D) +4

Sol. **(C)**

I = 5.0 A , T = 4.0 h

Moles of metal deposited = 1/4

Q = 5.0 x 4 x 60 x 60 columns

Charge in faradays

Q = $\frac{5\times4\times60\times60}{96500} = 0.75QF$

¼ ----- ¾ F charge required so f 1 moles $\frac{3}{4}\times 4 = 3f$

Oxidation = +3

8. The unbalanced equation for the reaction of P_4S_3 with nitrate in aqueous acidic medium is given below.

$$P_4S_3 + NO_3^- \rightarrow H_3PO_4 + SO_4^{2-} + NO$$

The number of mol of water required per mol of P_4S_3 is

(A) 18 (B) 8/3 (C) 8 (D) 28

Sol. **(B)**

$$P_4S_3 + NO_3- \rightarrow H_3PO_4 + SO_4^{2-} + NO$$

$$(P_4S_3 + 28H_2O \rightarrow 4H_3PO_4 + 3SO_4^{2-} + 44H^+ + 38e^-)\times 3$$

$$(NO_3^{-1} + 4H^+ + 3e^- \rightarrow NO + 2H_2O)\times 38$$

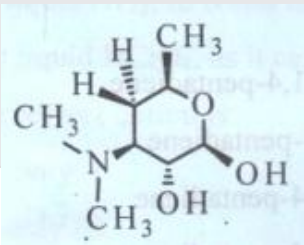
$$\therefore\ 3P_4S_3 + 38NO_3^- + 8H_2O + 2OH^+ \rightarrow 12H_3PO_4 + 9SO_4^{2-} + 38NO$$

9. Certain combinations of cations and anions lead to the formation of colored salts in solid state even though each of these ions with other counter ions may produce colorless salts. This phenomenon is due to temporary charge transfer between the two ions. Out of the following the salt that can exhibit this behavior is

(A) $SnCl_2$ (B) $SnCl_4$ (C) $SnBr_2$ (D) SnI_4

Sol. **(D)** Fajan rule

10. Desosamine has the following structure



The number of functional groups which react with hydroiodic acid, the number of chiral centers, and the number of stereoisomer's possible respectively are

(A) 4,5,8 (B) 3,4,16 (C) 3,4,8 (D) 4,4,16

Sol. **(B or D)**

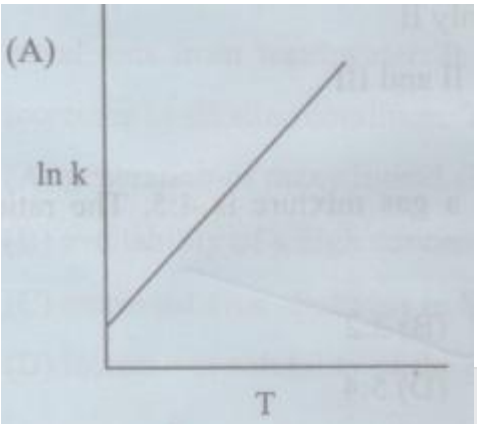
Number of functional group which react with HI = 4

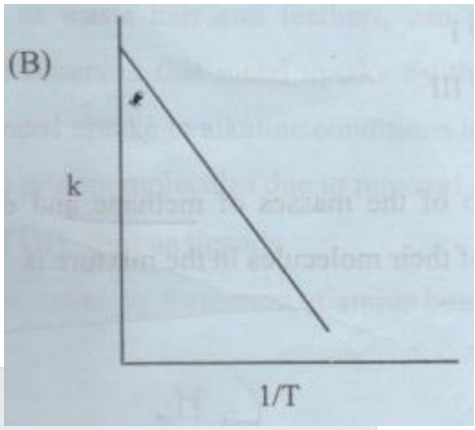
Number of chiral center = 4

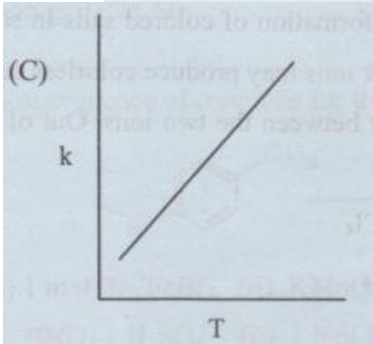
Number of possible isomers = $2^n = 2^4 = 16$

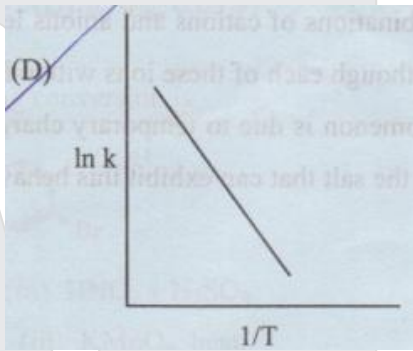
Notes : But number of different functional groups which may react with HI are 3-2º amine alcohol & ether (hemiacetal). From this point of view, (2) may also be a valid answer.

11. If k is the rate constant of the reaction and T is the absolute temperature, the correct plot is

(A) 

(B) 

(C) 

(D) 

Sol. **(D)**

$$K = Ae^{-E_a/RT}$$

$$\log K = \log A - \frac{E_a}{2.303RT}$$

12. 1,3-pentadiene and 1,4-pentadiene are compared with respect to their intrinsic stability and reaction with HI. The correct statement is:

(A) 1,3-pentadiene is more stable and more reactive than 1,4-pentadiene

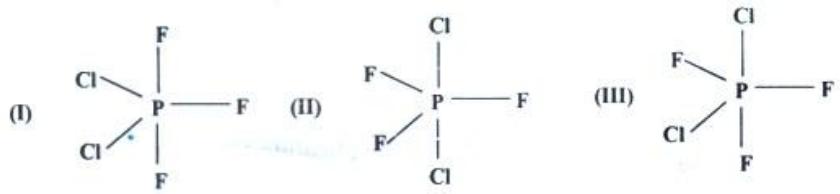
(B) 1,3-pentadiene is less stable and less reactive than 1,4-pentadiene

(C) 1,3-pentadiene is more stable but less reactive than 1,4-pentadiene

(D) 1,3-pentadiene is less stable but more reactive than 1,4-pentadiene

Sol. **(A)** Conjugated alkene are more stable and more reactive

13. From the given structures, the correct structures of PF_3Cl_2 is / are



(A) only I (B) only II (C) only III (D) I, II and III

Sol. **(A)** According to bents rule more electronegative occupy axial position and less electronegative atoms occupy equatorial position.

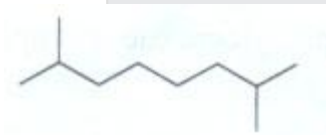
14. The ratio of the masses of methane and ethane In a gas mixture is 4:5. The ratio of number of their molecules in the mixture is:

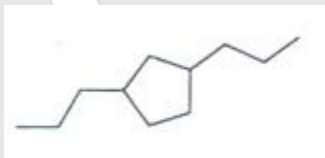
(A) 4:5 (B) 3:2 (C) 2:3 (D) 5:4

Sol. **(B)**

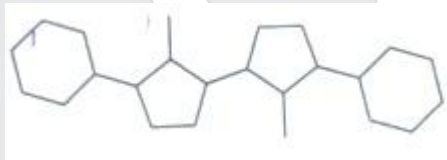
$$\frac{n_{CH_4}}{n_{C_2H_6}} = \frac{m_{CH_4}(M_{C_2H_6})}{(m_{CH_4})(M_{CH_4})} = 3:2$$

15. The hydrocarbon that cannot be prepared effectively by Wurtz reaction is

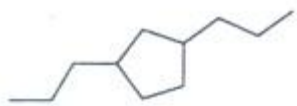
(A) 

(B) 

(C) 

(D) 

Sol. **(B)**



This compound can not form by Wurtz reaction. Wurtz reaction give symmetrical alkynes.

16. Glacial acetic acid dissolves in

(i) liquid H_2S, as H_2S is a polar covalent compound

(ii) liquid NH_3, as it can form hydrogen bond

(iii) liquid $HClO_4$, as it can protonate acetic acid

The correct option is

(A) only I (B) only II (C) only III (D) I, II and III

Sol. **(D)** Ammonia will form best hydrogen bond.

17. The energy of an electron in the first Bohr orbit is –13.6 eV. The energy of Be^{3+} in the first excited state is

(A) –30.6 eV (B) –40.8 eV (C) –54.4 eV (D) +40.8 eV

Sol. **(C)**

Z = 4

$$E = -13.6\left(\frac{2^2}{n^2}\right)$$

$$= -13.6\left(\frac{4^2}{2^2}\right)$$

= - 13.6 (4) = -54.4 ev

18. Many protein-based biomaterials, such as waste hair and feathers, can absorb heavy metal ions from wastewater. It has been observed that metal uptake by these materials increases in alkaline condition. The enhanced uptake in alkaline conditions is due to

(A) generation of many ligand sites in the protein molecules due to removal of H+

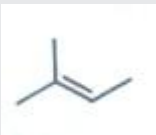
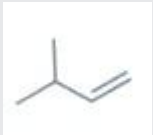
(B) availability of a high concentration of OH- ions as ligands

(C) Increased cross – linkages in the protein chains by formation of amide bonds

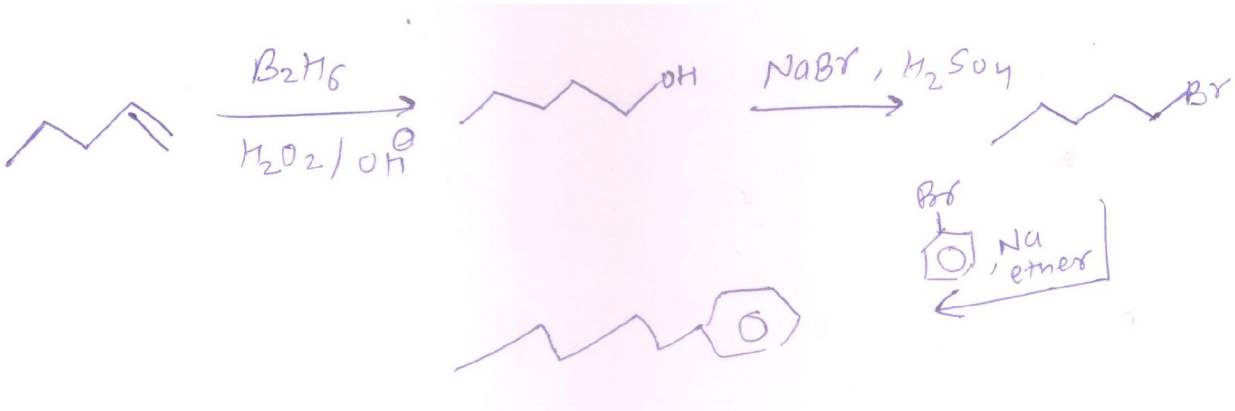
(D) increase in solubility of the proteins

Sol. **(A)**

19. Compound "X" reacts with diborane followed by alkaline hydrogen peroxide to form compound "Y". "Y" on reaction with a mixture of sodium bromide in sulphuric acid followed by bromobenzene and sodium in ether gives n-pentylbenzene. Compound "X" is

(A)  (B)  (C)  (D) 

Sol. **(D)**



20. When any solution passes through a cation exchange resin that is in acidic form, H ion of the resin is replaced by cations of the solution. A solution containing 0.319g of an isomer with molecular formula $CrCl_3.6H_2O$ is passed through a cation exchange resin in acidic form. The eluted solution requires $19cm^3$ of 0.125 N NaOH. The isomer is

(A) triaquatrichloro chromium (III) chloride trihydrate

(B) hexaaqua chrominum (III) chloride

(C) pentaaquamonochloro chromium (III) chloride monohydrate

(D) tetraaquadichloro chromium (III) chloride dihydrate

Sol. **(C)**

21. In an experiment, it was found that for a gas at constant temperature, PV = C. The value of C depends on

(A) atmospheric pressure (B) quantity of gas

(C) molecular weight of gas (D) volume of chamber

Sol. **(B)**

PV =C

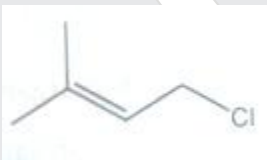
C = nRT

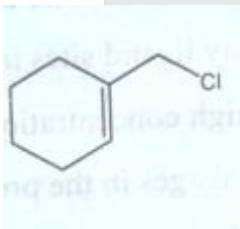
T = constant

$C \propto n$

22. The compound that undergoes solvolysis in aq. Ethanol most easily is

(A) 

(B) 

(C) 

(D) 

Sol. **(B)**

23. Silver nitrate solution when added to a colorless aqueous solution E forms a white precipitate which dissolves in excess of E. If the white precipitate is heated with water it turns black and the supernatant solution gives a white precipitate with acidified barrum nitrate solution. Therefore, E is

(A) Na_2S (B) $Na_2S_2O_3$ (C) Na_2SO_3 (D) Na_2SO_4

Sol. **(B)** $AgNO_3 + Na_2S_2O_3 \rightarrow Ag_2S_2O_3 \xrightarrow{Na_2S_2O_3} Ag(S_2O_3)_2^{-3}$

24. The metal M crystallizes in a body centered lattice with cell edge 400 pm. The atomic radius of M is.

(A) 200pm (B) 100pm (C) 173pm (D) 141pm

Sol. **(C)**

A = 400 pm in body central lattice $\sqrt{3}a = 4r$

$$r = \frac{\sqrt{3}a}{4}$$

$$\sqrt{3} \times 100 = 173\,pm$$

25. The vapor pressure of benzene is 53.3 kPa at 60.3°C, but it fall to 51.5 kPa when 19g of a nonvolatile organic compound is dissolved in 500g benzene. The molar mass of the nonvolatile compound is

(A) 82 (B) 85 (C) 88 (D) 92

Sol. **(B)**

P^0 = 53.3 KPa

P_s = 51.5 KPa

$$\frac{P^0 - P_s}{P_s} = \frac{n}{N} = \frac{19 \times 78}{M \times 500}$$

M = 51 g

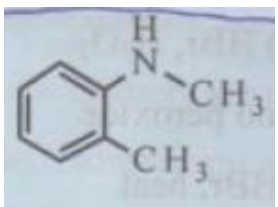
26. Sodium metal dissolves in liquid ammonia and forms a deep blue solution. The color is due to absorption of light by

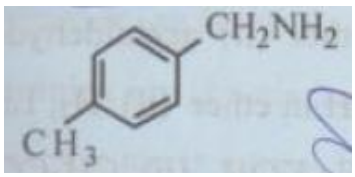
(A) sodium ions (B) ammoniated electrons

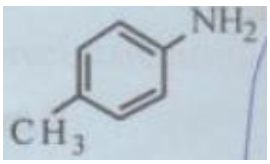
(C) free electrons (D) ammoniated sodium ions

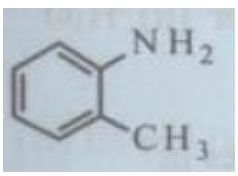
Sol. **(B)**

27. An organic base (X) reacts with nitrous acid at 0°C to give a clear solution. Heating the solution with KCN and cuprous cyanide followed by continued heating with conc. HCI gives a crystalline solid. Heating this solid with alkaline potassium permanganate gives a compound which dehydrates on heating to a crystalline solid. “X” is -

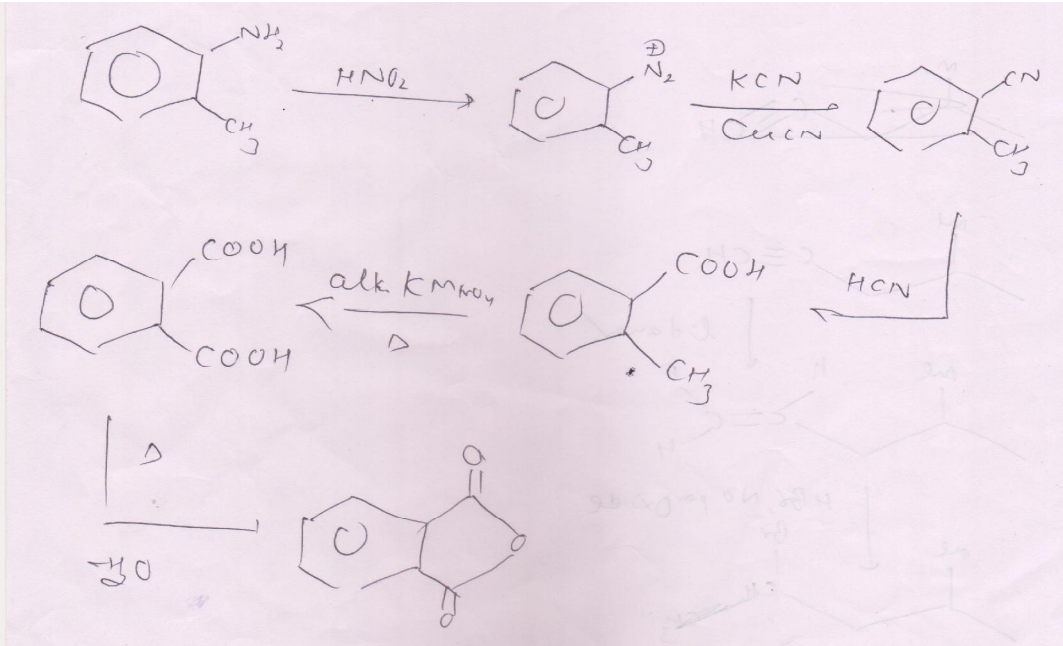
(A) 

(B) 

(C) 

(D) 

Sol. **(D)**



28. The de Brogile wavelength of an object of mass 33 g moving with a velocity of $200 ms^{-1}$ is of the order of

(A) 10^{-31}m (B) 10^{-34}m (C) 10^{-37}m (D) 10^{-41}m

Sol. **(B)**

M = 33 g = 33 x 10^{-3} kg

V = 200 ms^{-1}

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{6.63\times10^{-34}}{3.3\times10^{-3}\times200} = 10^{-34} \text{ m}$$

29. A person having osteoporosis is suffering from lead poisoning. Ethylene diamine tetra acetic acid (EDTA) is administered for this condition. The best form of EDTA to be used for such administration is -

(A) EDTA (B) tetrasodium salt

(C) disodium salt (D) calcium dihydrogen salt

Sol. **(D)**

30. A water sample from a municipal water supply was found to have a pH = 7.0. On evaporating 2 L of this water, 2. 016 g of white solid was left behind in the evaporation vessel, i.e., the total dissolved solid (TDS) content of this water was 1008 mg L^{-1}. However, addition of soap to a bucket of this water did not produce any visible scum. Based on these findings, one can conclude that

(A) There are no Ca^{2+} or Mg^{2+} ion in the water

(B) There are no CO_3^{2-} or HCO_3^- ion in the water

(C) concentration of any ion in the water is lower than 0.038M

(D) water may be containing Na^+ ions in concentration > 0.04M

Sol. **(A)**

31. The best reaction sequence to convert 2-methyl-1-bromopropane into 4-methyl-2-bromopentane is

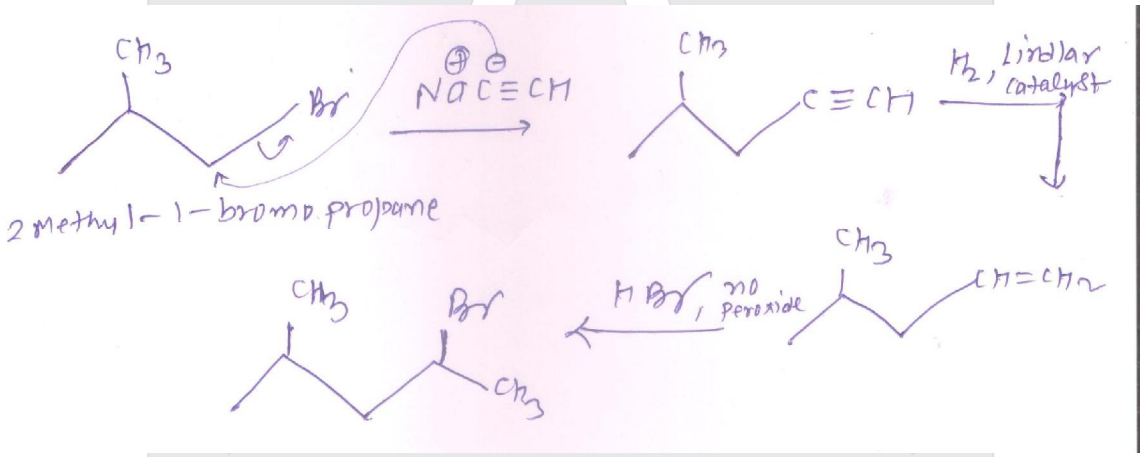
(A) (i) Mg in ether (ii) acetaldehyde (iii) H^+, H_2O (iv) Δ (v) HBr, H_2O_2

(B) (i) NaC≡CH in ether (ii) H_2, Lindlar catalyst (iii) HBr, no peroxide

(C) (i) alcoholic KOH (ii) CH_3COOOH (iii) H_2/Pt (iv) HBr, heat

(D) (i) NaC≡CH in ether (ii) H_3O^+ + $HgSO_4$ (iii) HBr, heat

Sol. **(B)**



32. Metallic copper dissolves in

(A) dilute HCl (B) Concentrated HCl (C) aqueous KCN (D) pure ammonia

Sol. **(C)**

$2Cu + 4KCN + 2H_2O \rightarrow 2K[Cu(CN)_2] + 2KOH + H_2$

33. A 50mL solution of pH = 1 is mixed with a 50mL solution of pH = 2. The pH of the mixture is

(A) 0.86 (B) 1.26 (C) 1.76 (D) 2.26

Sol. **(B)**

Sol - I V_1 = 50 ml $C_1 = 10^{-1}$ M

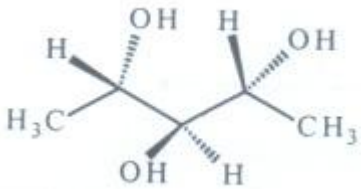
Sol - II V_2 = 50 ml $C_1 = 10^{-2}$ M

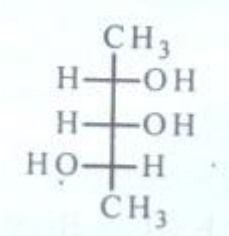
V_f = 100 ml

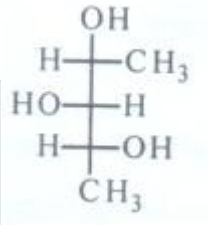
$$C_f = \frac{10^{-1} \times 50 + 10^{-2} \times 50}{100} = 0.055 \text{ M}$$

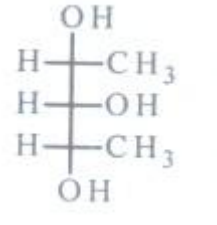
pH = – log (0.055) = 1.26

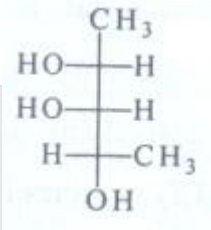
34. The Fischer projection formula that represents the following compounds is



(A) 

(B) 

(C) 

(D) 

Sol. **(D)**

35. Four statements for the following reaction are given below

$[CoCl_2(NH_3)_4]^+ + Cl^- \rightarrow [CoCl_3(NH_3)_3] + NH_3$

(i) only one isomer is produced if the reactant complex ion is a trans isomer

(ii) three isomers are produce if the reactant complex ion is a cis isomer

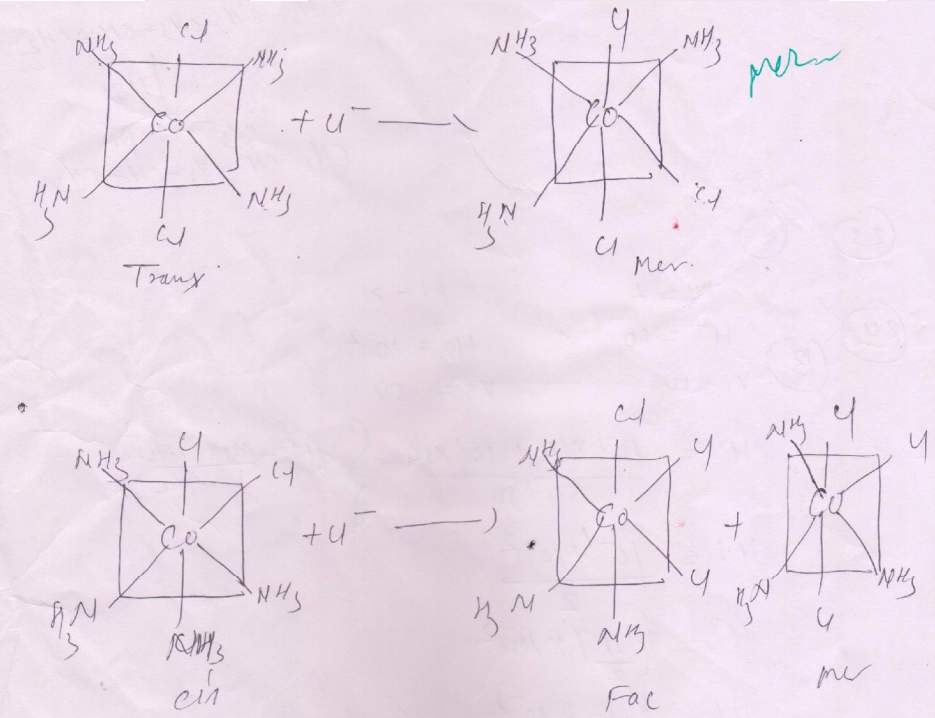
(iii) two isomers are produced if the reactant complex ion is a trans isomer

(iv) two isomers are produced if the reactant complex ion is cis isomer

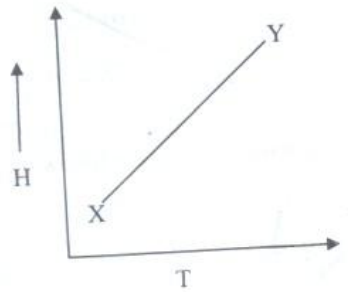
The correct statements are

(A) I and II (B) III and IV (C) I and IV (D) II and III

Sol. **(C)**



36. The process in which an ideal gas undergoes change from X to Y as shown in the following diagram is



(A) isothermal compression (B) adiabatic compression
(C) isothermal expansion (D) adiabatic expansion

Sol. **(B)**

$$dH = nC_p dT$$

37. With respect to halogens, four statements are given below

(I) The bond dissociation energies for halogens are in the order : $I_2 < F_2 > Br_2 < Cl_2$

(II) The only oxidation state is -1

(III) The amount of energy required for the excitation of electrons to first excited state decreases progressively as we move from F to I

(IV) They form HX_2^- species in their aqueous solutions (X = halogen)

The correct statements are

(A) I, II, IV (B) I, III, IV (C) II, III, IV (D) I, III

Sol. **(D)**

38. The order of reactivity of the following compounds in electrophilic monochlorinatic the most favorable position is

(A) I < II < IV < III (B) III < IV < I < II (C) IV < III < II < I (D) III < II < IV < I

Sol. **(B)** Because of +m effect of OCH_3 group and +Hyperconjugation effect of CH_3 group.

39. The limiting molar conductivities of KCl, KNO_3, and $AgNO_3$ are 149.9, 145.0 and 133.4 S cm^2 mol^{-1}, respectively, at 25°C. The limiting molar conductivity of AgCl at the same temperature in S cm^2 mol^{-1} is

(A) 128.5 (B) 138.3 (C) 161.5 (D) 283.3

Sol. **(B)**

$$\lambda_{AgCl} = \lambda_{AgNO_3} + \lambda_{KCl} - \lambda_{KNO_3}$$

= 133.4 +149.9 – 145

= 138.3 S cm^2 mol^{-1}

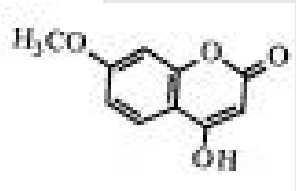
40. Imagine that in any atom about 50% of the space is occupied by the atomic nucleus. If a silver foil is bombarded with α - particles, majority of the α -particles would

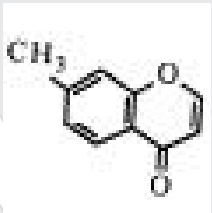
(A) be scattered (B) be absorbed by the nuclei

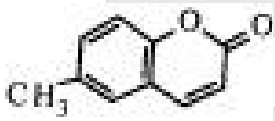
(C) pass through the foil undeflected (D) get converted into photons

Sol. **(A)**

41. An organic compound ("X") is a disubstituted benzene containing 77.8% carbon and 7.5% hydrogen. Heating an alkaline solution of "X" with chloroform gives a steam volatile compound "Y". Heating "Y" with acetic anhydride and sodium acetate gives a sweet smelling crystalline solid "Z". "Z" is

(A) 

(B) 

(C) 

(D) 

Sol. **(C)**

42. The emf of a cell corresponding to the following reaction is 0.199 V at 298 K.

Zn (S) + 2 H^+ (aq) $\rightarrow$ Zn^{2+} (0.1 M) + H_2 (g) ($E^0_{Zn/Zn+2}$ = 0.76V)

The approximate pH of the solution n at t e electrode where hydrogen is being produced is (p_{H2} = 1 atm)

(A) 3 (B) 9 (C) 10 (D) 11

Sol. **(C)**

$$E_{cell} = E^0_{cell} + \frac{0.0591}{n}\log\frac{[H^+]^2}{[Zn^{2+}]}$$

$$0.199 - 0.76 = \frac{0.0591}{2}\log\frac{[H^+]^2}{[0.1]}$$

pH = 10

43. The vapor pressure of two pure isomeric liquids X and Y are 200 torr and 100 torr respectively at a given temperature. Assuming a solution of these components to obey Raoult's law, the mole fraction of component X in vapor phase in equilibrium with the solution containing equal amounts of X and Y, at the same temperature, is

(A) 0.33 (B) 0.50 (C) 0.66 (D) 0.80

Sol. **(C)**

$$\frac{200}{2}+\frac{100}{2}=150$$

$$(P_T)y_1=100$$

$$(P_T)y_2=50$$

$$y_1=\frac{2}{3}$$

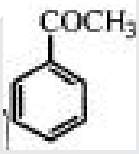
$$y_2=\frac{1}{3}$$

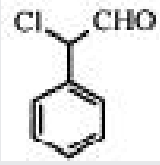
Mole fraction of x = 2/3 = 0.66

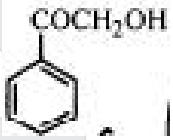
44. n-Butylcyclohexane is formed through the following sequence of reactions.

In the above scheme of reactions, "X" is –

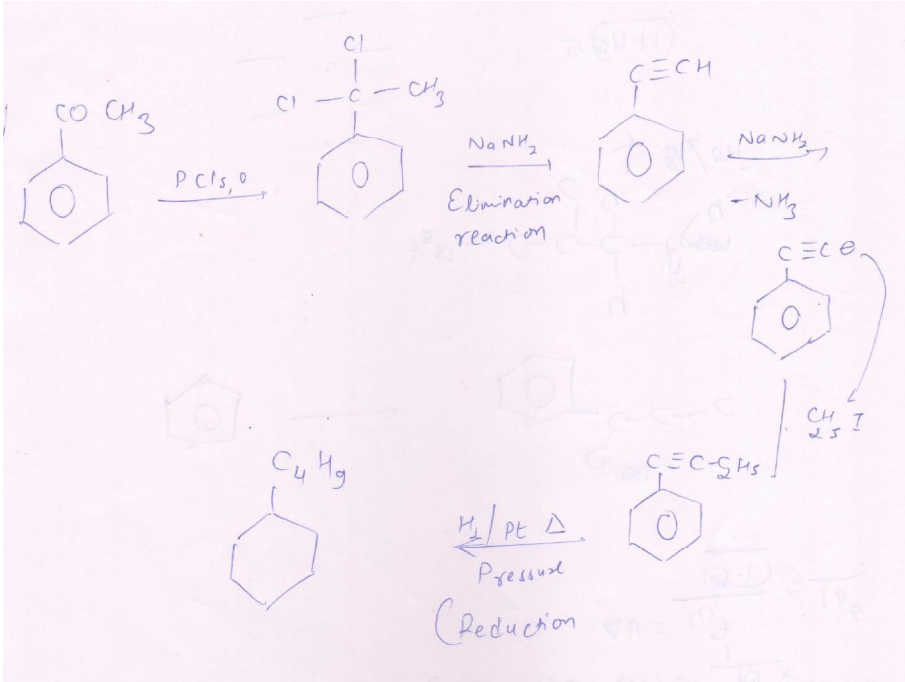
(A) 

(B) 

(C) 

(D) 

Sol. **(B)**



45. In a first order reaction, 75% of the reactant disappears in 1.386 h, the rate constant of the reaction is close to

(A) 7.2 X 10^{-3} S^{-1} (B) 3.6 X 10^{-3} S^{-1} (C) 1.8 X 10^{-3} S^{-1} (D) 2 .8 X 10^{-4} S^{-1}

Sol. **(D)**

$$A \rightarrow \frac{A}{2} \rightarrow \frac{A}{4}$$

$$2t_{1/2} = 1.388h$$

$$t_{1/2} = 0.693h = \frac{0.693}{k}$$

$$K = \frac{1}{3600} Sec^{-} = 2.8 \times 10^{-4}\ S^{-1}$$

46. Four statements for Cr and Mn are given below.

(i) Cr^{2+} and Mn^{3+} have the same electronic configuration.

(II) Cr^{2+} is a reducing agent while $Mn^{3+}$is an oxidizing agent.

(III) Cr^{2+} is an oxidizing agent while Mn^{3+} is a reducing agent

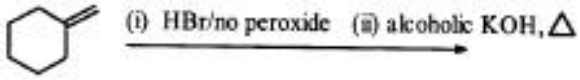
(IV) both Cr and Mn are oxidizing agents.

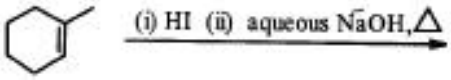
The correct statements are

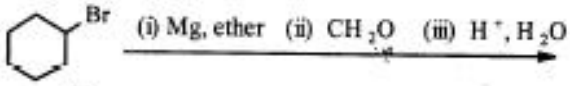
(A) I, III, IV (B) I, II (C) I, II, IV (D) I, IV

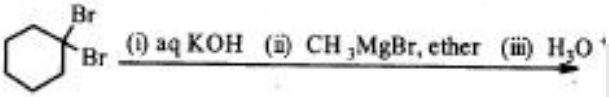
Sol. **(B)**

47. Four processes are indicated below:

(I) 

(II) 

(III) 

(IV) 

The processes that do not produce 1-methylcyclohexanol are

(A) II, IV (B) I, II (C) III, IV (D) I, III

Sol. **(D)**

48. The reaction that is least feasible is

(A) $Li_2CO_3 \rightarrow Li_2O + CO_2$

(B) $4Li + O_2 \rightarrow 2\ Li_2O$

(C) $6Li + N_2 \rightarrow 2Li_3N$.

(D) $2C_6H_5C\equiv CH + 2Li \rightarrow 2C_6H5C\equiv CLi + H_2$

Sol. **(A or D)**

Needs heating while others are possible at room.

Note : Should be according to NCERT Page 296 s-block.

49. Glucose when dissolved in water leads to cooling of the solution. Suppose you take 250 mL water at room temperature in an open container (such as a bowl) made of thermally insulated material and dissolve a spoonful' of glucose in it. If you are able to accurately measure the heat absorbed by this solution in reaching back to room temperature (assuming negligible changes in the composition and the amount of solution during this process), you will be measuring

(A)The enthalpy of dissolution of the glucose in water

(B) The Gibbs free energy of dissolution of the glucose in Water

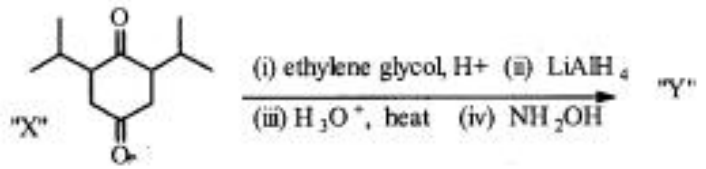
(C) The work done by the atmosphere on the system during the dissolution process

(D) The heat capacity of the solution

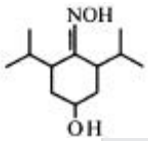
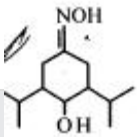
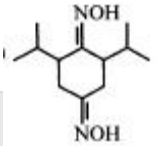
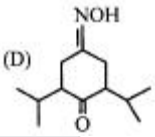
Sol. **(A)**

It is endothermic process.

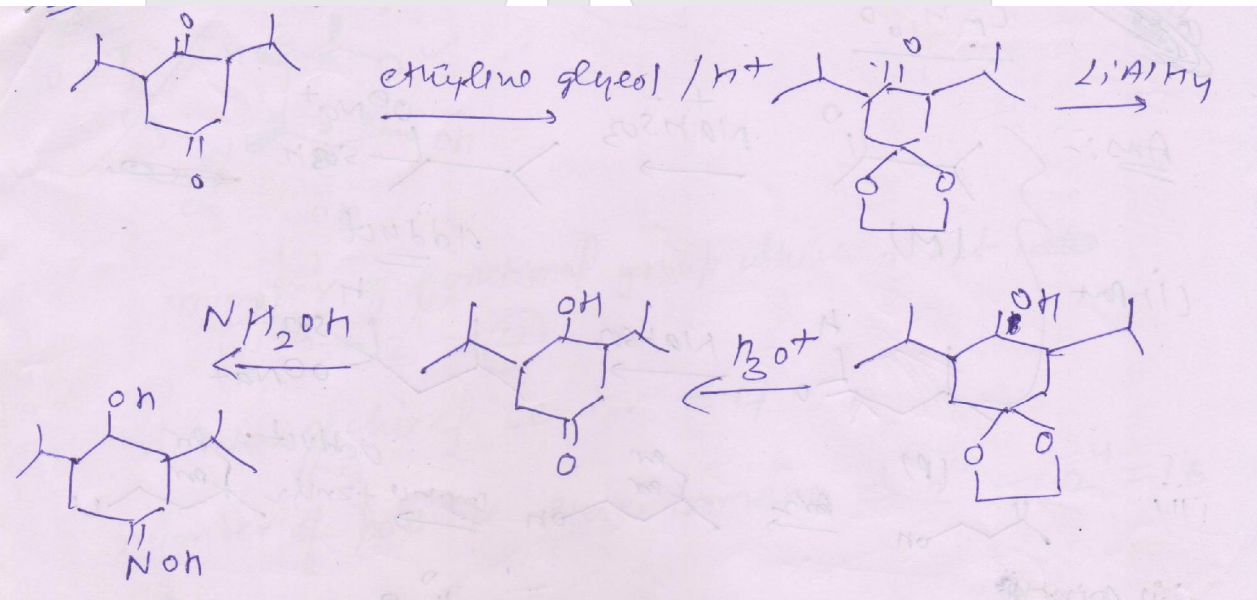
50. Compound "X" undergoes the following sequence of reactions to form "Y".



Compound "Y" is-

(A) 
(B) 
(C) 
(D) 

Sol. **(B)**



51. The complex that shows optical activity is

(A) *trans*-$[CoCl_2(en)_2]^+$ (B) *cis*-$[CoCl_2(en)_2]^+$

(C) *trans*-$[PtCl_2(NH_3)_2]$ (D) $[CoCl_2(NH_3)_2(en)]^+$

Sol. **(B)** no plane of symmetry

52. 100 mL of 0.3 M acetic acid is shaken with 0.8 g wood charcoal. The final concentration of acetic acid in the solution after adsorption is 0.125 M. The mass of "acetic acid adsorbed per gram of charcoal is

(A) 1.05 g (B) 0.0131 g (C)1.31 g (D) 0.131 g

Sol. **(C)**

Mass adsorbed= $\frac{100(0.3-0.125)60}{1000} = (0.3-0.125)6$

Mass adsorbed per gram of charcoal $= \frac{(0.3-0.125)6}{0.8}$ =1.3125

53. The reaction that does not produce nitrogen is

(A) heating $(NH_4)_2Cr_2O_7$ (B) NH_3, + excess of Cl_2

(C) heating of NaN_3 (D) heating of NH_4NO_3

Sol. **(B)**

Normal heating ; $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

but; **Explosion ;** $NH_4NO_3 \xrightarrow[\text{explosion}]{\Delta} N_2 + \frac{1}{2}O_2 + 2H_2O$

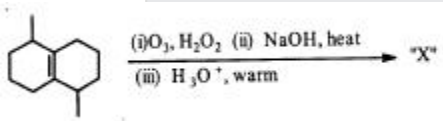
$NH_3 + 3Cl_2(\text{excess}) \longrightarrow NCl_3 + 3HCl$

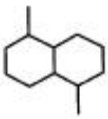
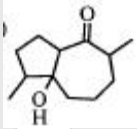
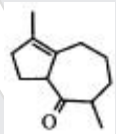
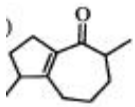
54. The species having highest bond energy is

(A) O_2 (B) O_2^+ (C) O_2^- (D) O_2^{2-}

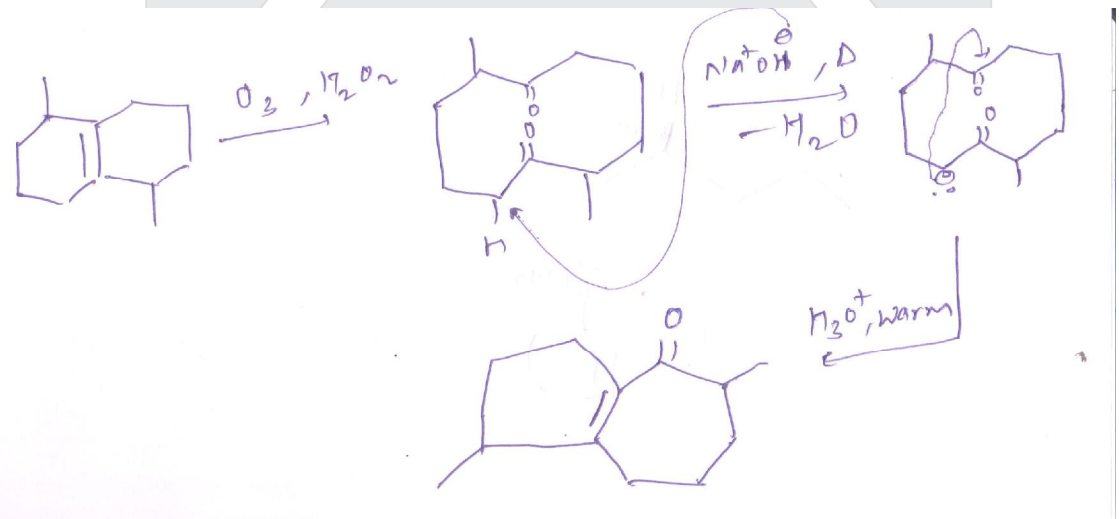
Sol. **(B)** Bond order $\propto$ Bond energy O_2^+ bond order is 2.5

55. The product ("X") of the following sequence of reactions is

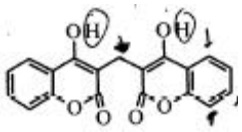


(A)  (B)  (C)  (D) 

Sol. **(D)**



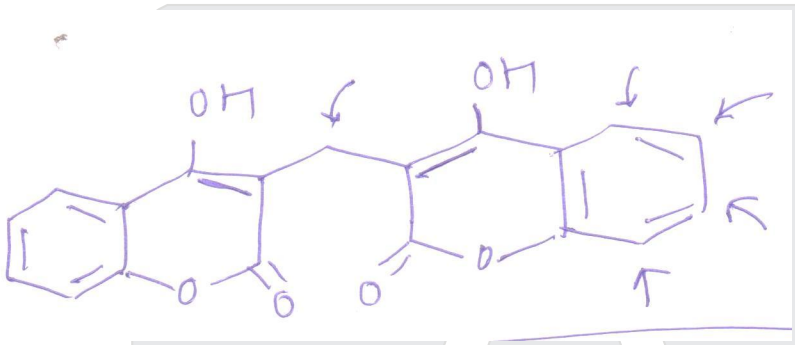
56. Dicomarol (X) is an anticoagulant The number of possible monochloro substituted isomeric derivatives and the volume of hydrogen liberated at STP by the reaction of 0.5 mol of dicoumarol with sodium are respectively



(X)

(A) 5, 22.4 dm^3 (B) 5, 11.2 dm^3 (C) 6, 11.2 dm^3 (D) 4, 22.4 dm^3

Sol. **(B)**



Number of possible monochloro substituted isomeric derivatives = 5, as shown in figure

Volume of hydrogen liberated at STP by the reaction of 0.5 mole of dicoumarol with sodium = 11.2 dm^3

57. The structure of a molecule of $N(SiMe_3)_3$ is

(A) Pyramidal with angle close to 110° A (B) T-shaped with angle 90°

(C) Bent T-shaped with angle close to 89^0; (D) Trigonal planar with bond angle close to 120^0

Sol. **(D) p** π - d π back bonding between N and Si

58. For an electron whose x-positional uncertainty is 1.0 x 10^{-10} m, the uncertainty in the x Component of the velocity in m s^{-1} will be of the order of

(A) 10^6 (B)10^9 (C)10^2 (D) 10^{15}

Sol. **(A)** $\delta v = \dfrac{h}{4\pi m \delta x}$

$$= \frac{6.625\times10^{-34}}{9.1\times10^{-3^1}\times10^{-10}\times4\times3.14} = 10^6$$

59. The order of $p\pi - d\pi$ interaction in the compounds containing bond between Si/P/S/Cl and oxygen is in the order

(A) P>Si>Cl>S (B) Si<P<S<Cl (C) S<Cl<P<Si (D) Si>P>S>Cl

Sol. **(B)** Due to high electronegativity of Cl and small size of Cl atoms

60. The solubility products (K_{sp}) of three salts MX, MY_2 and MZ_3 are 1 x 10^{-8}, 4 x 10^{-9} and 27 x 10^{-8}, respectively. The correct order for solubilities of these salts is

(A) Mx > MY_2 > MZ_3 (B) MZ_3 > MY_2 > MX (C) MZ_3>MX>MY_2 (D) MY_2>MX>MZ_3

Sol. **(B)**

$$S = \sqrt{K_{sp}} \qquad S = \sqrt[3]{\frac{K_{sp}}{4}} \qquad S = \sqrt[4]{\frac{K_{sp}}{27}}$$

61. Three isomeric compounds M, N, and P ($C_5H_{10}O$) give the following tests:

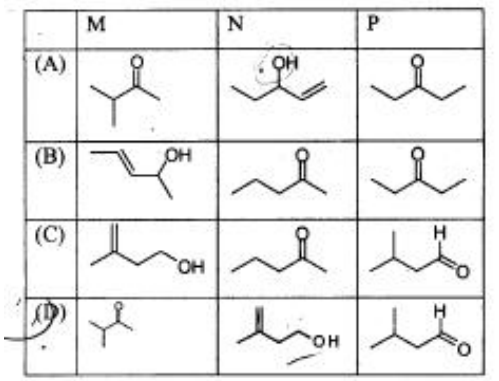
(i) M and P react with sodium bisulfite to form an adduct J

(ii) N consumes I mol of bromine and also gives turbidity with conc. HCI/anhydrous $ZnCl_2$ after prolong heating '

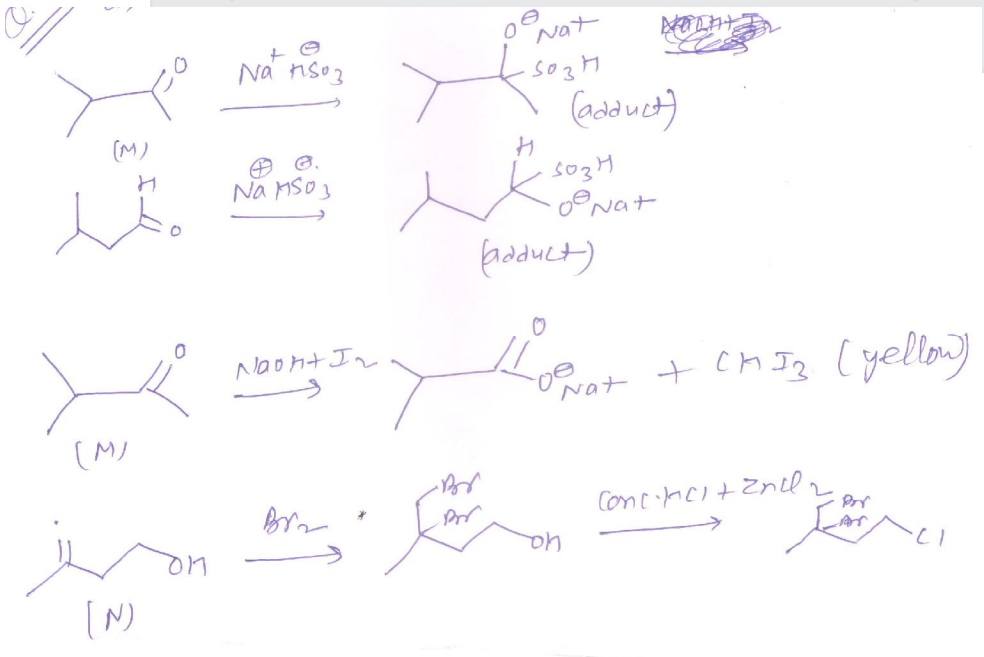
(iii) M reacts with excess of iodine in alkaline solution to give yellow crystalline compound with a characteristic smell.

(iv) p-Rosaniline treated with sulphur dioxide develops pink colour on shaking with **P**

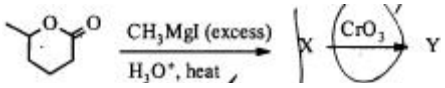
The structure of M,N, and P, respectively are

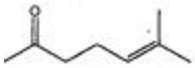
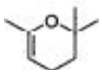
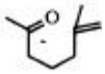


Sol. **(D)**

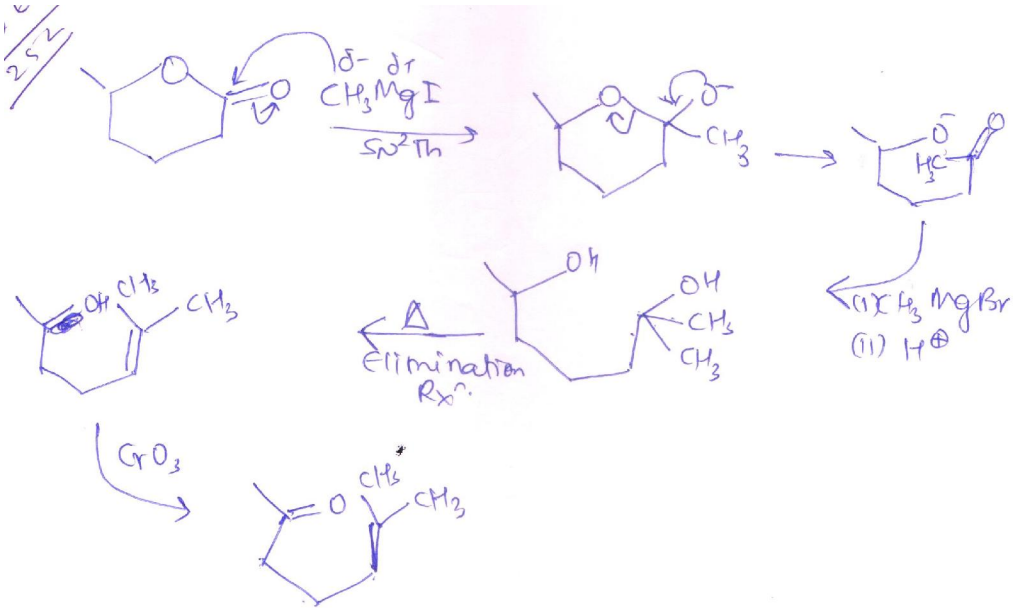


62. The major product(Y) of the following reaction is –

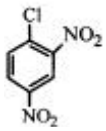
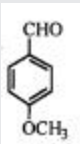
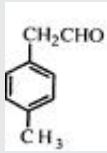
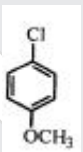


(A)  (B)  (C)  (D) 

Sol. **(A)**



63. The compound that will NOT react with hot concentrated aqueous alkali at atmospheric pressure is

(A)  (B)  (C)  (D) 

Sol. **(D)** Due to electron releasing groups decreases the rate of electrophilic substitution reaction

64. The nature of $CsAuCl_3$ is (this compound contains Au in two oxidation states and there is no Au-Au bond)

(A) diamagnetic (B) paramagnetic (C) ferromagnetic (D) antiferromagnetic

Sol. **(A)**

Au have two oxidation state +3 and +1 in this compound .

$CsAuCl_2$ and $CsAuCl_4$ are present in 1 : 1 ratio.

65. The standard electrode potentials, E^0 of Fe^{3+}/Fe^{2+} and Fe^{2+}/Fe at 300 K are +0.77 V and -0.44 V, respectively. The E^0 of Fe^{3+}/F e at the same temperature is

(A) 1.21 V (B) 0.33 V (C) –0.036 V (D) 0.036 V

Sol. **(C)**

$$Fe^{3+} + e^- \rightarrow Fe^{2+} \Delta G_1^0$$

$$Fe^{2+} + 2e^- \rightarrow Fe \Delta G_2^0$$

$$\Delta G_3^0 = \Delta G_1^0 + \Delta G_2^0$$

$$(E^0\, Fe^{3+}/Fe) = \frac{(1)(0.77) + 2(-0.44)}{3} = \frac{-0.11}{3} = -0.036V$$

66. The incorrect statement for lanthanides among the following statements is

(A) 4f and 5d orbitals are so close in energyythat it is very difficult to locate the exact position of electrons in lanthanides

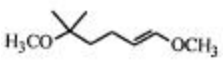
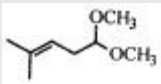
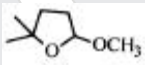
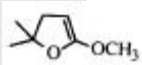
(B) most common stable oxidation state is +3

(C) tripositive lanthanide ions have characteristic color depending on nature of group with which they combine to form compounds

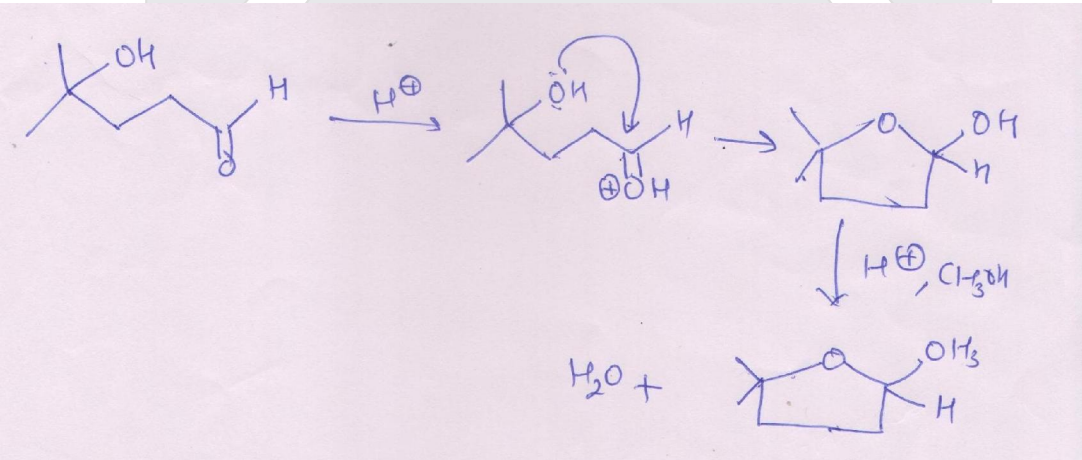
(D) some lanthanide ions absorb either in infrared or ultraviolet region of electromagnetic spectrum

Sol. **(C)** All lanthanide have no characteristic colour.

67. 4-Hydroxy-4-methylpentanal on heating with excess of methanol in the presence of an acid catalyst followed by dehydration of the product gives

(A)  (B)  (C)  (D) 

Sol. **(C)**



68. Ice crystallizes in a hexagonal lattice. At ascertain low temperature, the lattice constants are a = 4.53 A and c = 7.41 A. The number of H_2O molecules contained in a unit cell (d $\approx$0.92 g cm^{-3} at the given temperature) is

(A) 4 (B) 8 (C)12 (D) 24

Sol. **(A)**

69. In the redox reaction

$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

20 mL of 0.1 M $KMnO_4$ react quantitatively with

(A) 20 mL of 0.1 M oxalate (B) 40 mL of 0.1 M oxalate

(C) 50 mL of 0.25 M oxalate (D) 50mL of 0.1 M oxalate

Sol. **(D)** Valency factor of $KMnO_4 = 5$

Valency factor of oxalate = 2

$5\ M_1\ V_1 = 2M_2\ V_2$

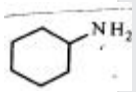
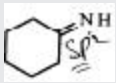
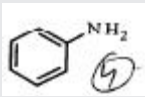
70. The reaction that does not proceed in forward direction is

(A) $BeF_2 + HgI_2 \rightarrow BeI_2 + HgF_2$ (B) LiI + CSF -> LiF + CSI

(C) $CuI_2 + 2CuF \rightarrow CuF_2 + 2CuI$ (D) $CaS + H_2O \rightarrow CaO + H_2S$

Sol. **(A)** Iodide ion can't displace by fluoride ion

71. The order of basicity of the following compounds is

(I)  (II)  (III)  (IV) 

(A) I > II > IV > III (B) IV > II > I > II (C) III > II > I > IV (D) I > II > III > IV

Sol. **(A)** In III lp of nitrogen involve in aromatization, in IV lp is delocalized, in II is nitrogen is sp^2 hybridized and in I nitrogen sp^3 hybridized.

72. The appropriate sequence of reactions for obtaining 2-phenylbutanoic acid from benzene is

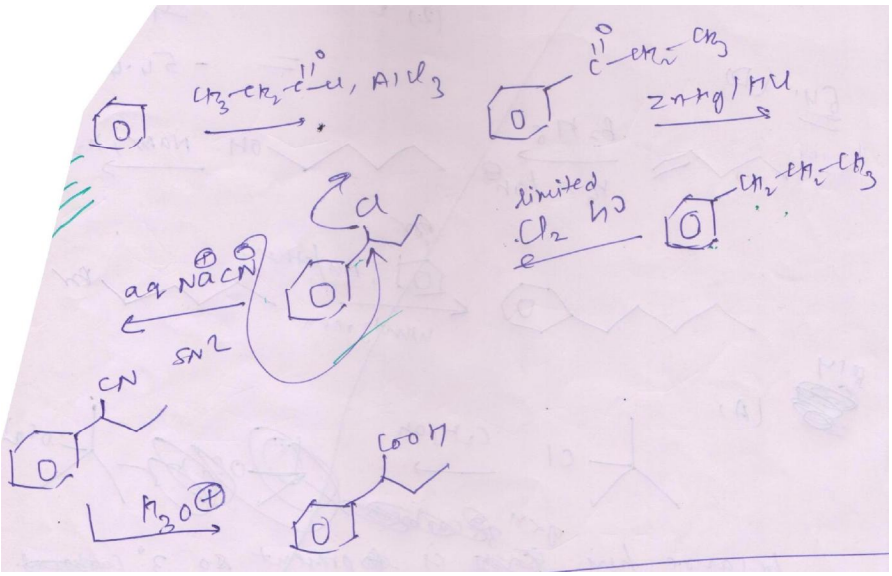
(A) (i) 1-chlorobutane/$AlCl_3$ (ii) limited Cl_2, light (iii) aq NaCN (iv) H+, HZO, heat

(B) (i) 2-chlorobutane/$AlCl_3$ (ii) K_2Cr_2O7/H_2SO_4

(C) (i) propanoyl chloride/$AlCl_3$ (ii) Zn-Hg/HCl (iii) limited Cl(g), light (iv) aq. NaCN (v) H^+, H_2O, heat

(D) (i) butanoyl chloride/$AlCl_3$ (ii) $NaBH_4$ (iii) CuCN (iv) H+, H_2O, heat

Sol. **(C)**



73. The quantity that does not change for a sample of a gas in a sealed rigid container when it is cooled from 120°C to 90°C at constant volume is

(A) average energy of the molecule (B) pressure of the gas

(C) density of the gas (D) average speed of the molecules

Sol. **(C)** Density = $\frac{Mass}{Volume}$, During the process total mass of gas remain constant.

74. An ideal gas taken in an insulated chamber is released into interstellar space. The statement that is nearly true for this process is

(A)Q=0,W $\neq$ 0 (B)W=0,Q $\neq$ o

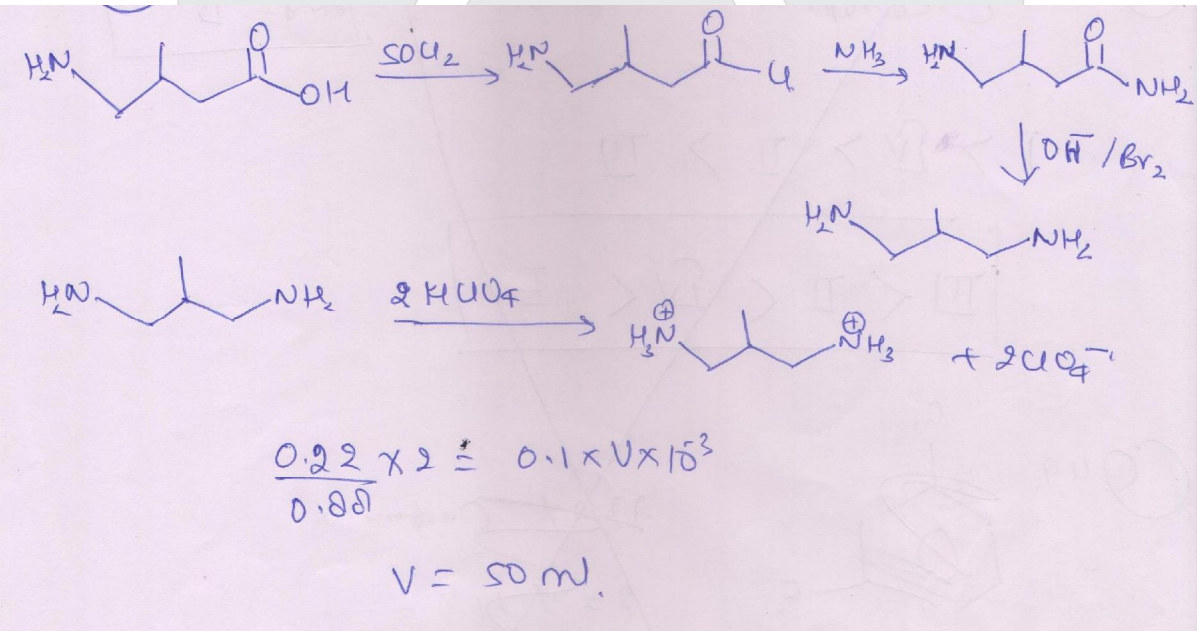
(C) Δ U=0,Q $\neq$ 0 (D) Q=W= Δ U=0

Sol. **(D)** $P_{external}$ = zero it means during the expension of gas work done is zero. As result change in internal energy zero and heat absorb or emit.

75. 4-amino-3-methylbutanoic acid is treated with thionyl chloride followed by ammonia to obtain compound "X". "X" on reaction with bromine in an alkaline medium gave compound "Y". For estimation, "Y" was titrated with perchloric acid. The volume of 0.1_M pefchloric acid needed to react with 0.22 g of "Y" is

(A) 50 mL (B) 80 mL (C) 120 mL (D) 200 mL

Sol. **(A)**



76. For $[FeF_6]^{3-}$ and $[CoF_6]^{3-}$, the statement that is correct is

(A) both are colored (B) both are colorless

(C) $[FeF_6]^{3-}$ is colored and $[CoF_6]^{3-}$ is colorless (D) $[FeF_6]^{3-}$ is colorless and $[CoF_6]^{3-}$ is colored

Ans. **(B)**

Sol. Due to d-d transition of unpaired electrons and it is paramagnetic.

77. Cotton fibers consist of cellulose polymers with neighboring polymers chains held together by hydrogen bonds between -OH groups in the glucose units. Due to these hydrogen bonds

(A) cotton is insoluble in water

(B) cotton can easily absorb ghee and oils and therefore are used to make wicks in traditional lamps A if

(C) it is easier to iron cotton clothes when they are slightly wet or by applying steam to the clothes

(D) cotton clothes have a high wear and tear than other fibers

Sol. **(C)** Because water from hydrogen bond with glucose polymeric chain.

78. For the following reaction, formation of the product is favored by

$A_2(g) + 4B_2(8) << 2AB_4(g)$, $\Delta H < 0$

(A)low temperature and high pressure (B) High temperature and low pressure

(C) low temperature and low pressure (D) High temperature and high pressure

Sol. **(A)** According to le-chaliter principle low temperature favour exo-thermic direction and High pressure favour the direction in which volume decrease.

79. Imagine a hypothetical situation in which capacity of any molecular orbital d of 2 and the combination rules for the formation of molecular orbitals remain the same. The number of delocalized i-electrons stipulated by the modified Huckel's rule of aromateicity is (n= integer, including zero)

(A) (3n + 2) (B) (4n + 3) (C) (2n + 3) (D) (6n + 3)

Sol. **(D)**

80. One mole crystal of a metal halide of the type MX with molecular weight 119 g having face centered cubic structure with unit cell length 6.58 A was recrystallized. The density of the recrystallized crystal was found to be 2.44 g cm^{-3}. The type of defect introduced during the recrystalization is

(A) a ditional M^+ and X^- ions at interstitial sites (B) Schottky defect

(C) F-centre (D) Frenkel defect

Sol. **(B)**

Calculated density d = Z x $\frac{molermass}{N_a \times volume}$ = 2.78 g cm^{-3}

Is greater then actual density 2.44 g cm^{-3} therefore density decreases and defect is Schottky defect