JEE (Main) QUESTION PAPER 2024

29th January Shift 2

Time : 3 Hours **Total Marks : 300**

General Instructions :

1. *There are three subjects in the question paper consisting of Chemistry Q. no. 1 to 30.*
2. *This Paper is divided into two sections:*
   - *Section A Consists of 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE is correct.*
   - *Section B consist of 10 questions, **Numerical Value Type Questions** - In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.*
3. *There will be only one correct choice in the given four choices in Section A. For each question 4 marks will be awarded for correct choice, 1 mark will be deducted for incorrect choice for Section A questions and zero mark will be awarded for not attempted question.*
4. *For Section B questions, 4 marks will be awarded for correct answer and zero for unattempted and incorrect answer.*

Chemistry

Section A

Q. 1. Which of the following acts as a strong reducing agent? (Atomic number: Ce = 58, Eu = 63, Gd = 64, Lu = 71)

(1) Lu^{3+} **(2)** Ce^{4+}

(3) Gd^{3+} **(4)** Eu^{2+}

Q. 2. Which of the following statements are correct about Zn, Cd and Hg?

a. They exhibit high enthalpy of atomization as the d-subshell is full.

b. Zn and Cd do not show variable oxidation state while Hg shows +I and +II.

c. Compounds of Zn,Cd and Hg are paramagnetic in nature.

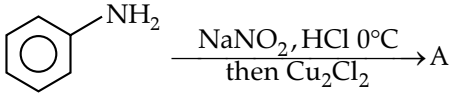
d. Zn,Cd and Hg are called soft metals.

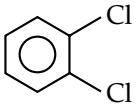
Choose the most appropriate from the options given below:

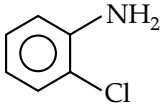
(1) b, c only **(2)** a, d only

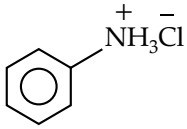
(3) c, d only **(4)** b, d only

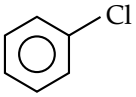
Q. 3. The product A formed in the following reaction is

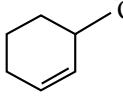


(1) 

(2) 

(3) 

(4) 

Q. 4. According to IUPAC system, the compound 

is named as :

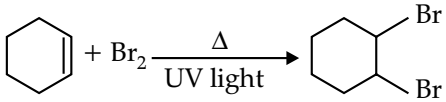
(1) Cyclohex-1-en-3-ol

(2) Cyclohex-2-en-1-ol

(3) Cyclohex-1-en-2-ol

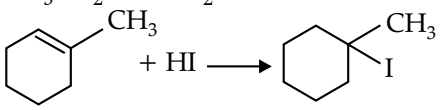
(4) 1-Hydroxyhex-2-ene

Q. 5. Which of the following reaction is correct?

(1) 

(2) $C_2H_5CONH_2 + Br_2 + NaOH \rightarrow C_2H_5CH_2NH_2 + Na_2CO_3 + NaBr + H_2O$

(3) $CH_3CH_2CH_2NH_2 \xrightarrow[H_2O]{HNO_2,\ 0°C} CH_3CH_2OH + N_2 + HCl$

(4) 

Q. 6. The element having the highest first ionization enthalpy is

(1) C **(2)** Al

(3) Si **(4)** N

Q. 7. Given below are two statements:

Statement I : Fluorine has most negative electron gain enthalpy in its group.

Statement II : Oxygen has least negative electron gain enthalpy in its group.

In the light of the above statements, choose the most appropriate from the options given below

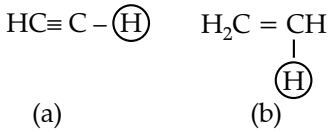
(1) Statement I is false but Statement II is true.

(2) Both Statement I and Statement II are true.

(3) Both Statement I and Statement II are false.

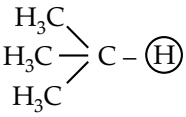
(4) Statement I is true but Statement II is false.

Q. 8. The ascending acidity order of the following H atoms is :



(a)

(b)



(c)

(d)

(1) a < b < c < d **(2)** d < c < b < a

(3) a < b < d < c **(4)** c < d < b < a

Q. 9. Match List I with List II

List- I (Bio Polymer)	List-II (Monomer)
(a) Starch	(i) nucleotide
(b) Cellulose	(ii) α-glucose
(c) Nucleic acid	(iii) β-glucose
(d) Protein	(iv) α-amino acid

Choose the correct answer from the options given below :

(1) a-ii, b-iii, c-i, d-iv **(2)** a-ii, b-i, c-iii, d-iv

(3) a-iv, b-ii, c-i, d-iii **(4)** a-i, b-iii, c-iv, d-ii

Q. 10. The correct IUPAC name of K_2MnO_4 is

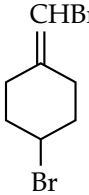
(1) Potassium tetraoxidomanganese (VI)

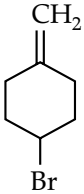
(2) Potassium tetraoxidomanganate (VI)

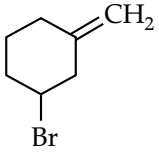
(3) Dipotassium tetraoxidomanganate (VII)

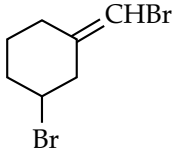
(4) Potassium tetraoxopermanganate (VI)

Q. 11. Which one of the following will show geometrical isomerism?

(1) 

(2) 

(3) 

(4) 

Q. 12. Anomalous behavior of oxygen is due to its

(1) small size and high electronegativity

(2) small size and low electronegativity

(3) large size and high electronegativity

(4) large size and low electronegativity

Q. 13. Alkyl halide is converted into alkyl isocyanide by reaction with

(1) NaCN **(2)** AgCN

(3) NH_4CN **(4)** KCN

Q. 14. A reagent which gives brilliant red precipitate with Nickel ions in basic medium is

(1) dimethyl glyoxime

(2) meta-dinitrobenzene

(3) sodium nitroprusside

(4) neutral $FeCl_3$

Q. 15. On passing a gas, 'X', through Nessler's regent, a brown precipitate is obtained. The gas 'X' is

(1) Cl_2 **(2)** H_2S

(3) CO_2 **(4)** NH_3

Q. 16. Phenol treated with chloroform in presence of sodium hydroxide, which further hydrolyzed in presence of an acid results

(1) Benzene-1, 2-diol

(2) Benzene-1, 3-diol

(3) 2-Hydroxybenzaldehyde

(4) Salicylic acid

Q. 17. Match List I with List II :

List- I (Spectral Series for Hydrogen)	List-II (Spectral Region / Higher Energy State)
(a) Lyman	(i) Infrared region
(b) Balmer	(ii) UV region
(c) Paschen	(iii) Infrared region
(d) Pfund	(iv) Visible region

Choose the correct answer from the options given below :

(1) a-i, b-iii, c-ii, d-iv **(2)** a-ii, b-iii, c-i, d-iv

(3) a-ii, b-iv, c-iii, d-i **(4)** a-i, b-ii, c-iii, d-iv

Q. 18. Match List I with List II :

List- I (Compound)	List-II (pK_a value)
(a) Ethanol	(i) 10.0
(b) Phenol	(ii) 15.9
(c) m-Nitrophenol	(iii) 7.1
(d) p-Nitrophenol	(iv) 8.3

Choose the correct answer from the options given below :

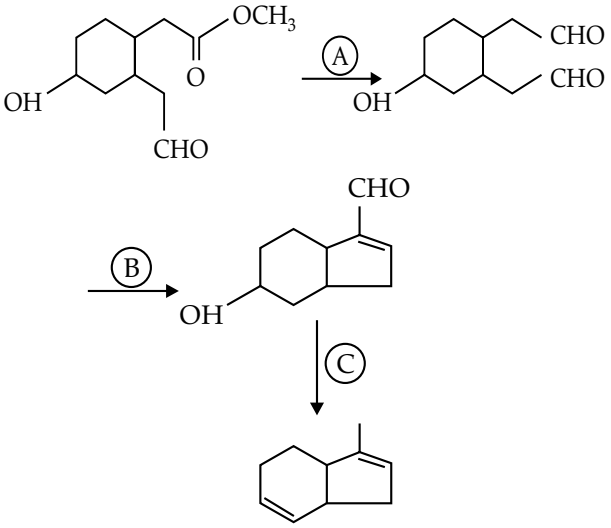
(1) a-i, b-ii, c-iii, d-iv

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

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

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

Q. 19. Identify the reagents used for the following conversion :



(1) A = $LiAlH_4$, B = $NaOH_{(aq)}$, C = NH_2 – NH_2/KOH, ethylene glycol

(2) A = DIBAL-H, B = $NaOH_{(aq)}$, C = NH_2-NH_2/KOH, ethylene glycol

(3) A = DIBAL-H, B = $NaOH_{(alc)}$, C = Zn/HCl

(4) A = $LiAlH_4$, B = $NaOH_{(alc)}$, C = Zn/HCl

Q. 20. Chromatographic technique/s based on the principle of differential adsorption is/are

a. Column chromatography

b. Thin layer chromatography

c. Paper chromatography

Choose the most appropriate answer from the options given below:

(1) b only **(2)** a only

(3) a & b only **(4)** c only

Section B

Q. 21. The total number of anti bonding molecular orbitals, formed from 2s and 2p atomic orbitals in a diatomic molecule is ..... .

Q. 22. Standard enthalpy of vapourisation for CCl_4 is 30.5 kJ mol^{-1}. Heat required for vapourisation of 284 g of CCl_4 at constant temperature is ..... kJ.
(Given molar mass in 1 $gmol^{-1}$; C = 12, Cl = 35.5)

Q. 23. The total number of 'Sigma' and 'Pi' bonds in 2-formylhex-4-enoic acid is ..... .

Q. 24. If 50 mL of 0.5M oxalic acid is required to neutralise 25 mL of NaOH solution, the amount of NaOH in 50 mL of given NaOH solution is ..... g.

Q. 25. The oxidation number of iron in the compound formed during brown ring test for NO_3^- ion is ..... .

Q. 26. The half-life of radioisotope bromine –82 is 36 hours. The fraction which remains after one day is ..... $\times 10^{-2}$.
(Given antilog 0.2006 = 1.587)

Q. 27. A constant current was passed through a solution of $AuCl_4^-$ ion between gold electrodes. After a period of 10.0 minutes, the increase in mass of cathode was 1.31 g . The total charge passed through the solution is ..... $\times 10^{-2}$ F.
(Given atomic mass of Au = 197)

Q. 28. Molality of 0.8 M H_2SO_4 solution (density 3 1.06 g cm^{-3}) is ..... $\times 10^{-3}$ m.

Q. 29. The total number of molecules with zero dipole moment among CH_4, BF_3, H_2O, HF, NH_3, CO_2 and SO_2 is .....

Q. 30. The following concentrations were observed at 500 K for the formation of NH_3 from N_2 and H_2. At equilibrium; $[N_2] = 2 \times 10^{-2}$M, $[H_2] = 3 \times 10^{-2}$M and $[NH_3] = 1.5 \times 10^{-2}$M. Equilibrium constant for the reaction is ..... .

■■■

Answer Key

Chemistry			
Q. No.	**Answer**	**Topic Name**	**Chapter Name**
1	(4)	Electronic Configuration of f Block	d and f Block Elements
2	(4)	Properties of d Block Element	d and f Block Elements
3	(4)	Diazotization Reaction	Haloalkanes and Haloarene
4	(2)	IUPAC Naming	Organic Chemistry Some Basic Principle and Technique
5	(4)	Methods of Preparation	Alcohol Phenol Ether
6	(4)	Ionization Energy	Periodic Properties
7	(1)	Negative Electron Gain Enthalpy	Periodic Properties
8	(4)	Acidic Character	Hydrocarbon
9	(1)	Polysacchrides	Biomolecule
10	(2)	IUPAC Naming of Coordination Compound	Co ordination Compound
11	(4)	Geometrical Isomerism	Organic Chemistry Some Basic Principle
12	(1)	Oxygen Family	p block
13	(2)	Nucleophillic Subsitution Reaction	Haloalkanes and Haloarene
14	(1)	Qualitative Analysis	Qualitative Analysis
15	(4)	Nitrogen Family	p block Element
16	(3)	Reimer Tiemann Reaction	Alcohol Phenol Ether
17	(3)	Line Spectra of Hydrogen Atom	Atomic Structure
18	(2)	Acidic Character of Phenol	Alcohol Phenol Ether
19	(3)	Methods of Preparation of Aldehyde	Aldehyde, Ketone and carboxylic Acid
20	(3)	Chromatography	Organic Chemistry Some Basic Principle and Technique
21	[4]	Molecular Orbital Theory	Chemical Bonding
22	[56]	Enthalpy of Vapourization	Thermodynamics
23	[22]	Sigma and pi Bond	Chemical Bonding
24	[4]	Equivalent Concept	Some Basic Concept of Chemistry
25	[1]	Oxidation State	Redox Reaction
26	[63]	Half life Time	Chemical Kinetics
27	[2]	Faraday Law	Electrochemistry
28	[815]	Molarity	Solution
29	[3]	Dipole Moment	Chemical Bonding
30	[417]	Equillibrium Constant	Chemical Equillibrium

JEE (Main) SOLVED PAPER 2024

29th January Shift 2

ANSWERS WITH EXPLANATIONS

Section A

1. Option (4) is correct.

Electronic configuration of Europium

$$Eu = [Xe]4f^7 6s^2$$

$$Eu^{2+} = [Xe]4f^7$$

But common oxidation state of lanthanide is +3.

$$\therefore \quad Eu^{2+} \rightarrow Eu^{3+} + e^-$$

So it acts as strong reducing Agent.

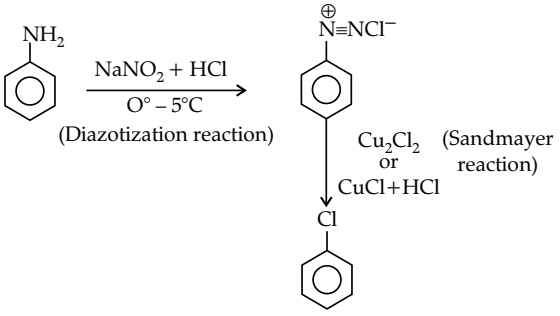
2. Option (4) is correct.

Zn, Cd and Hg have low enthalpy of atomization. So statement Ist is wrong.

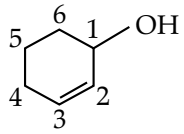
Zn, Cd do not show variable oxidation state, Hg show +I and +II oxidation state. So statement is correct.

In Zn, Cd, Hg are diamagnetic in nature in +2 oxidation state. Zn, Cd and Hg are called soft metal due to their fully filled *d*-orbital. So option 4 is correct.

3. Option (4) is correct.

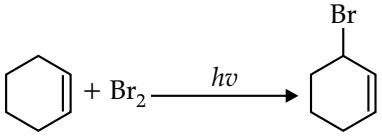


4. Option (2) is correct.



5. Option (4) is correct.

(1) Allylic subsitution will take place at high temperature



(2) During Hoffmann Bromide Reaction amine having less than one carbon atom as compare to amide is formed.

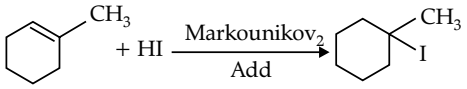
$$CH_3 - CH_2 - \underset{\underset{O}{\|}}{C} - NH_2 + Br + 4NaOH \longrightarrow$$

$$CH_3CH_2NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$$

(3) Alcohol with same no. of carbon Atom is formed (incorrect)

$$CH_3CH_2CH_2NH_2 \xrightarrow[H_2O]{HNO_2, O°C} CH_3CH_2CH_2OH + N_2 + HCl$$

(4)



(Correct)

6. Option (4) is correct.

N(7) – $1s^2 2s^2 2p^3$ (half-filled electronic configuration) since half filled electronic configuration are stable, So large amount of energy is required to remove electron.

7. Option (1) is correct.

In case of halogen order of –ve electron gainenthalpy

Cl > F > Br > I

In case of oxygen family order of –ve electron gainenthalpy

O < S > Se > Te

or

S > Se > Te > 0

8. Option (4) is correct.

$$CH \equiv C - H \rightarrow \underset{\downarrow}{CH \equiv C^{\ominus}} + H^{\oplus}$$

$$\text{sp}$$

$$CH_2 = CH_2 \rightarrow CH_2 = \underset{\downarrow}{CH^{\ominus}} + H^{\oplus}$$

$$sp^2$$

$$CH3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - H \rightarrow CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C^{\ominus}}} + H^{\oplus}$$

$$CH_3 - CH_3 \rightarrow CH_3 - CH_2^{\ominus} + H^{\oplus}$$

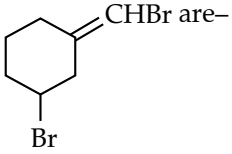
+ I effect

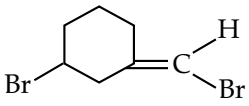
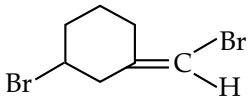
since sp hybridization % s character is high so electronegativity is high.
$\therefore$ Acidic character
c < d < b < a

9. Option (1) is correct.
- Starch consist α-Glucose as monomer unit.
  a-ii
- Cellulose consist β-Glucose as monomer unit.
  b-iii
- Protein are polymer of α-amino acids.
  d-iv
- Nucleic Acids are macromolecule of nucleotide.
  c-i

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

10. Option (2) is correct.
$+1\ x\ -2$
K_2MnO_4 Potassium tetra oxidomagnate (VI)
$+2 + x - 8 = 0$
$x = 6$

11. Option (4) is correct.
Geometrical isomers of  CHBr are–

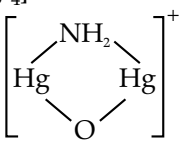



12. Option (1) is correct.
Oxygen shows anomalous behaviour due to small size and high electronegativity.

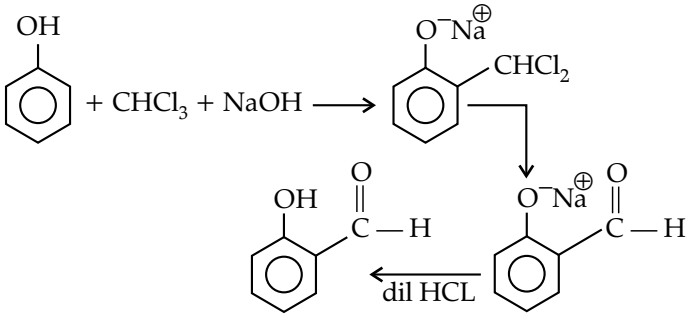
13. Option (2) is correct.
$R - X + AgCN \rightarrow R - N \equiv C + AgX$

14. Option (1) is correct.
Ni^{2+} DMG $\xrightarrow[\text{Medium}]{\text{Basic}}$ $[Ni(DMG)_2]$
Red ppt.

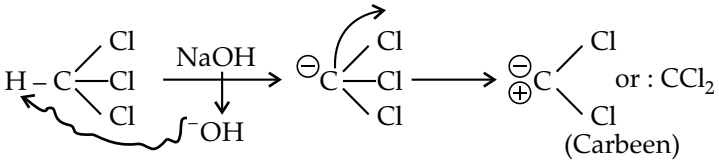
15. Option (4) is correct.
Ammonia on reaction with Nessler's reagent produces brown ppt

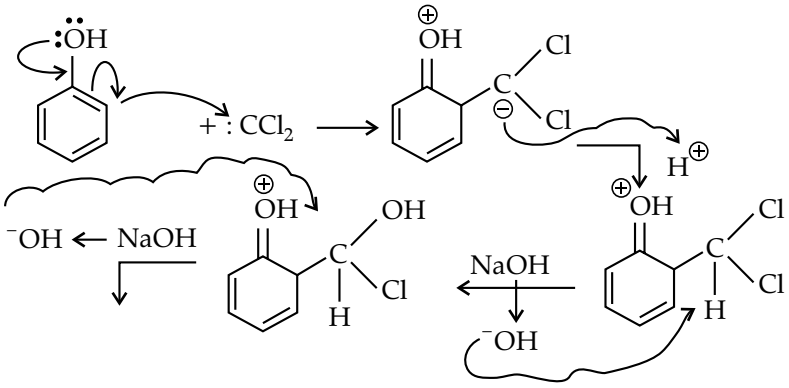
$NH_3 + 2K_2[HgI_4] \xrightarrow{3KOH}$  $I^- + 7KI + 2H_2O$
[Brown ppt]

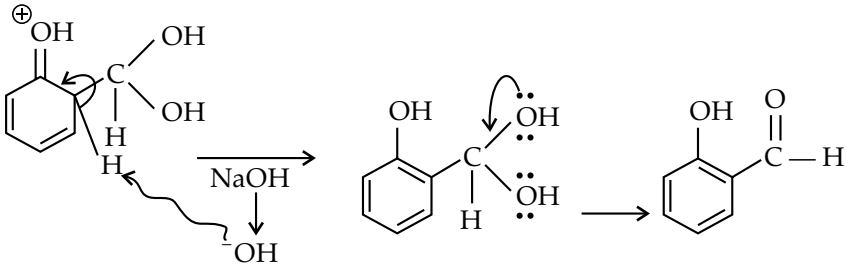
16. Option (3) is correct.



Mechanism:







17. Option (3) is correct.

Series — Region

Lyman — UV a-ii

Balmer — Visible b-iv

Paschen — IR c-iii

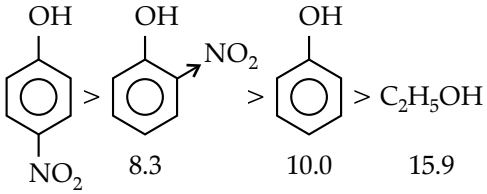
Bracket — IR

P fund — IR → d-i

18. Option (2) is correct.

Acidic Strength $\alpha \frac{1}{p\text{Ka}}$.

∴ Acidic Character order is

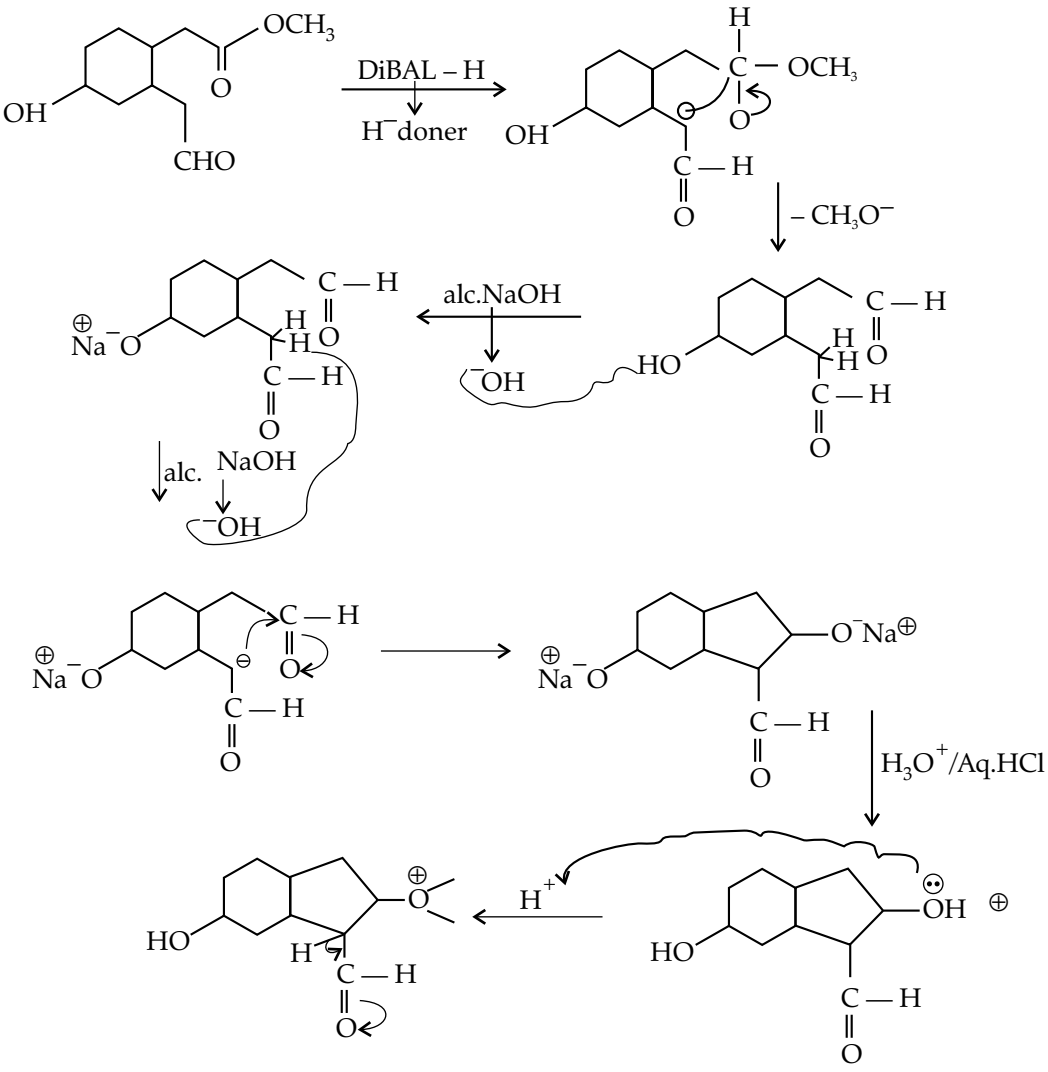


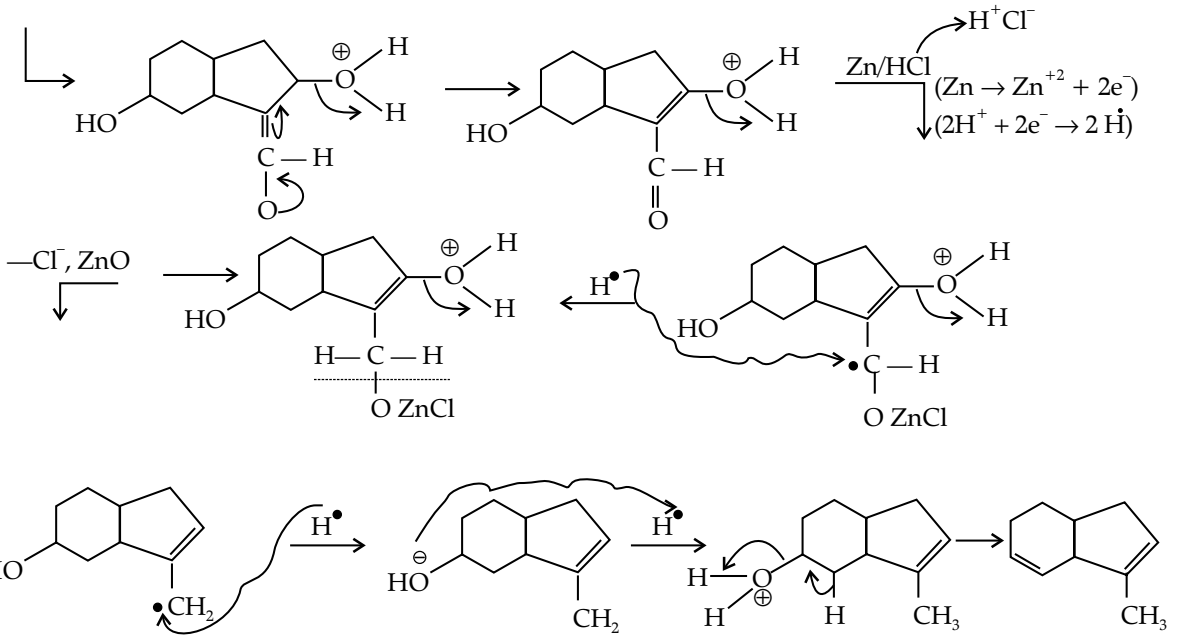
(7.1)

Due –I and –R effect of NO_2 group Acidic character of NO_2 group subituted phenol (↑)

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

19. Option (3) is correct.



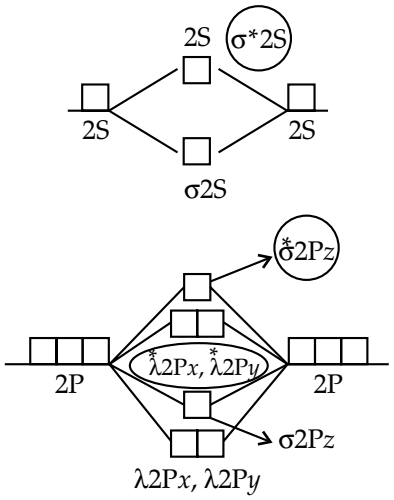


20. Option (3) is correct.

Column Chromatography and thin layer chromatography is based on differential adsorption. Paper chromatography is based on principle of portion.

Section B

21. Correct answer is [4].



So all antibonding are ($\overset{*}{\sigma}$ 2S, $\overset{*}{\pi}$ 2Px, $\overset{*}{\pi}$ 2Py, $\overset{*}{\sigma}$ 2Pz)

22. Correct answer is [56.24 kJ].

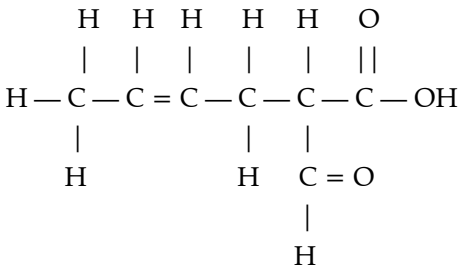
$$\text{no. of moles} = \frac{\text{Given Mass}}{\text{Moler Mass}} = \frac{284}{154} =$$

Enthalpy of vaporisation for $CC1_4$ = 30.5 KJ(mol)

$\therefore$ Total enthalpy of vaporisation

$$= \frac{284}{154} \times 30.5 = 56.24 \text{ kJ}$$

23. Correct answer is 22.



No. of Pi bond = 3 Total = 19 + 3 = 22

No. of σ bond = 19

24. Correct answer is [4].

g eqn. of NaOH = g eqn. of O.A

$n_f \times N_1 \times V_1 = n_f \times M_2 \times V_2$

$25 \times M = 0.5 \times 50 \times 2$

$M = 2$ mol litre

weight of NaOH present in some

$= 2 \times 50 \times 40 \times 10^{-3} = 4g$

25. Correct answer is [1].

The compound formed during brown ring test is $[Fe(H_2O)_5(NO)]^+[SO_4]^{\ominus}$

$x + 0 + 0 = +1$

$x = 1$

$\therefore$ 0.5 of iron is +1.

26. Correct answer is [63].

$$\text{T total} = n \times t_{\frac{1}{2}} \Rightarrow 24 = n \times 36$$

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

$$\text{N} = \left(\frac{\text{No}}{2}\right)^{n} = \frac{\text{No}}{(2)^{\frac{2}{3}}} = 63 \times 10^{-2}\,\text{No}$$

$\therefore$ Amount left $= 63 \times 10^{-2}$

27. Correct answer is [2].

$R \times n$ is $Au^{3+} + 3e^- = Au$

For 1 mole of Gold, charge required = 3F

$$\text{no. of moles} = \frac{\text{Given mass}}{\text{Molar mass}}$$

$$= \frac{1.3}{197}$$

$$= 0.00667 \text{ mol}$$

$\therefore$ For 0.00667 mol charge required

$$= 0.00667 \times 3 = 0.02$$

$$= 2 \times 10^{-2}\text{F}$$

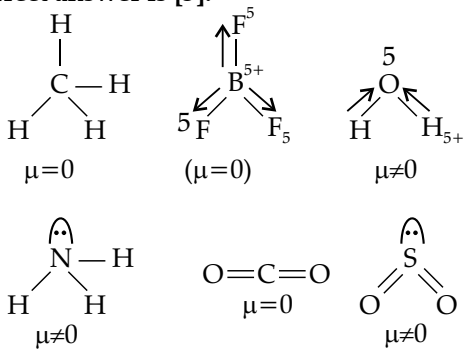
28. Correct answer is [815].

Relation b/w molarity and molality is

$$m = \frac{1000 \times \text{M}}{1000d - \text{MM}_2} = \frac{1000 \times 0.8}{(1000 \times 1.06) - (0.8 \times 98)}$$

$$= 814.9 \times 10^{-3} = 815 \times 10^{-3}$$

29. Correct answer is [3].



30. Correct answer is [417].

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

$$K_C = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

$$= \frac{[\text{Conc. of Produes}]^{\text{Stoichiometric coeff}}}{[\text{Conc. of Reactant}]^{\text{Stoichiometric coeff}}}$$

$$= \frac{(1.5 \times 10^{-2})^2}{(2 \times 10^{-2})(3 \times 10^{-2})^3}$$

$$= 0.04166 \times 10^4$$

$$= 416.6$$

$$= 417$$

■■■