JEE (Main) CHEMISTRY SOLVED PAPER

2023
06^{th} April Shift 1

General Instructions :

(i) *There are 30 questions in this section.*

(ii) *Section A consists of 20 Multiple choice questions and Section B consists of 10 Numerical value type questions. In Section B, candidates have to attempt any five questions out of 10.*

(iii) *There will be only one correct choice in the given four choices in Section A. For each question for Section A, 4 marks will be awarded for correct choice, 1 mark will be deducted for incorrect choice questions and zero mark will be awarded for not attempted questions.*

(iv) *For Section B questions, 4 marks will be awarded for correct answer and zero for unattempted and incorrect answer.*

(v) *Any textual, printed or written material, mobile phones, calculator etc. is not allowed for the students appearing for the test.*

(vi) *All calculations/ written work should be done in the rough sheet which is provided with Question Paper.*

Section A

1. Match List I with List II

List I **Enzymatic** reaction	**List** II **Enzyme**
(A) Sucrose $\rightarrow$ Glucose and Fructose	**I.** Zymase
(B) Glucose $\rightarrow$ ethyl alcohol and CO_2	**II.** Pepsin
(C) Starch $\rightarrow$ Maltose	**III.** Invertase
(D) Proteins $\rightarrow$ Amino acids	**IV.** Diastase

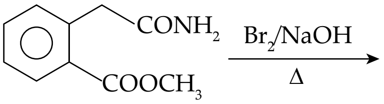
Choose the correct answer from the options given below:

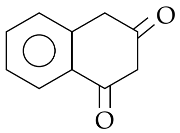
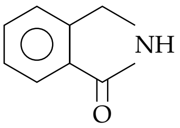
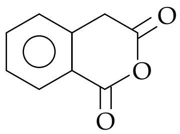
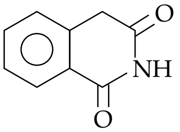
(1) (A) – III, (B) – I, (C) – IV (D) –II
(2) (A) – I, (B) – IV, (C) – III (D) –II
(3) (A) – III, (B) – I, (C) – II (D) –IV
(4) (A) – I, (B) – II, (C) – IV (D) –III

2. The standard electrode potential of M^+ / M in aqueous solution does not depend on

(1) Hydration of a gaseous metal ion
(2) Ionisation of a gaseous metal atom
(3) Ionisation of a solid metal atom
(4) Sublimation of a solid metal

3. The major product formed in the following reaction is

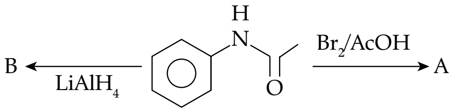


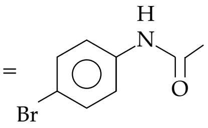
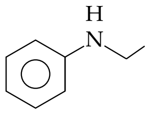
(1) 
(2) 
(3) 
(4) 

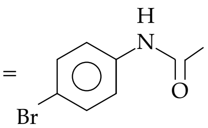
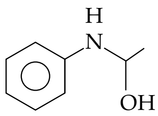
4. A compound is formed by two elements X and Y. The element Y forms cubic close packed arrangement and those of element X occupy one third of the tetrahedral voids. What is the formula of the compound?

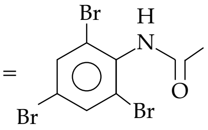
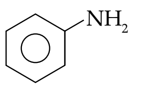
(1) X_3Y **(2)** XY_3 **(3)** X_2Y_3 **(4)** X_3Y_2

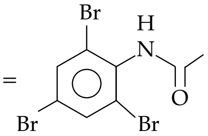
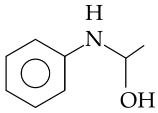
5. The major products A and B from the following reactions are:



(1) A =  B = 

(2) A =  B = 

(3) A =  B = 

(4) A =  B = 

6. Given below are two statements, one labeled as Assertion A and the other is labeled as Reason R

Assertion A: The spin only magnetic moment value for $[Fe(CN)_6]^{3-}$ is 1.74 BM, Whereas for $[Fe(H_2O)_6]^{3+}$ is 5.92 BM.

Reason R: In both complexes, Fe is present in +3 oxidation state.

In the light of the above statements, choose the correct answer from the options given below:

(1) A is false but R is true
(2) A is true but R is false

(3) Both A and R are true but R is not the correct explanation of A
(4) Both A and R are true but R is the correct explanation of A

7. Match List I with List II

List I Name of reaction	List II Reagent used
(A) Hell–Volhard–Zelinsky reaction	I. NaOH + I_2
(B) Iodoform reaction	II. (i) CrO_2Cl_2, CS_2 (ii) H_2O
(C) Etard reaction	III. Br_2 / red phosphorus (ii) H_2O
(D) Gatterman – Koch reaction	IV. CO, HCl, anhyd. $AlCl_3$

Choose the correct answer from the options given below:
(1) (A) – III, (B) – I, (C) – IV (D) –II
(2) (A) – I, (B) – II, (C) – III (D) –IV
(3) (A) – III, (B) – II, (C) – I (D) –IV
(4) (A) – III, (B) – I, (C) – II (D) –IV

8. Polymer used in orlon is
(1) Polyamide **(2)** Polycarbonate
(3) Polythene **(4)** Polyacrylonitrile

9. Which of the following options are correct for the reaction
$2[Au(CN_2)]^{-}(aq) + Zn(s) \rightarrow 2Au(s) + [Zn(CN)_4]^{2-}(aq)$
A. Redox reaction
B. Displacement reaction
C. Decomposition reaction
D. Combination reaction
Choose the correct answer from the options given below:
(1) A only **(2)** A and D only
(3) A and B only **(4)** C and D only

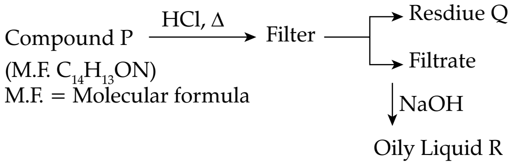
10. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: Loss of electron from hydrogen atom results in nucleus of ~ 1.5×10^{-3} pm size.
Reason R: Proton (H^+) always exists in combined form.
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Both A and R are correct and R is the correct explanation of A
(2) A is correct but R is not correct
(3) Both A and R are correct but R is NOT the correct explanation of A
(4) A is not correct but R is correct

11. For a concentrated solution of a weak electrolyte (K_{eq} = equilibrium constant) A_2B_3 of concentration 'c', the degree of dissociation 'α' is
(1) $\left(\frac{K_{eq}}{25c^2}\right)^{\frac{1}{5}}$ **(2)** $\left(\frac{K_{eq}}{108c^4}\right)^{\frac{1}{5}}$
(3) $\left(\frac{K_{eq}}{6c^5}\right)^{\frac{1}{5}}$ **(4)** $\left(\frac{K_{eq}}{5c^4}\right)^{\frac{1}{5}}$

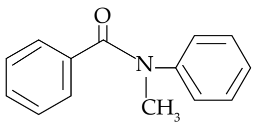
12. The setting time of cement is increased by adding
(1) Clay **(2)** Gypsum
(3) Limestone **(4)** Silica

13. The difference between electron gain enthalpies will be maximum between:
(1) Ar and F **(2)** Ne and F
(3) Ar and Cl **(4)** Ne and Cl

14. Strong reducing and oxidizing agents among the following, respectively, are
(1) Ce^{3+} and Ce^{4+} **(2)** Eu^{2+} and Ce^{4+}
(3) Ce^{4+} and Eu^{2+} **(4)** $Ce^{4+}$and Tb^{4+}

15.


Compound P is neutral, Q gives effervescence with $NaHCO_3$ while R reacts with Hinsbergs reagent to give solid soluble in NaOH. Compound P is

(1)


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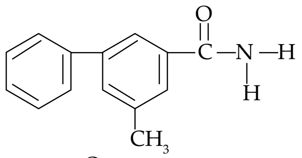

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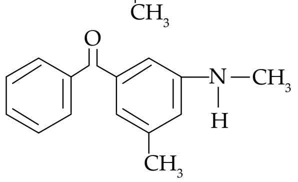

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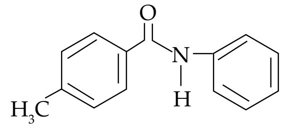


16. Match list I with list II

List I Element detected	List II Reagent used/Product formed
A. Nitrogen	I. $Na_2[Fe(CN)_5NO]$
B. Sulphur	II. $AgNO_3$
C. Phosphorous	III. $Fe_4[Fe(CN)_6]_3$
D. Halogen	IV. $(NH_4)_2MoO_4$

Choose the correct answer from the options given below:
(1) (A) – III, (B) – I, (C) – IV, (D) –II
(2) (A) – II, (B) – I, (C) – IV, (D) –III
(3) (A) – II, (B) – IV, (C) – I, (D) –III
(4) (A) – IV, (B) – II, (C) – I, (D) –III

17. The possibility of photochemical smog formation is more at
(1) Himalayan villages in winter
(2) Marshy lands

(3) Industrial areas
(4) The places with healthy vegetation

18. For the reaction

$$RCH_2Br + I^- \xrightarrow{\text{Acetone}} \underset{\text{major}}{RCH_2I} + Br^-$$

The correct statement is
(1) The reaction can occur in acetic acid also.
(2) The transition state formed in the above reaction is less polar than the localized anion.
(3) The solvent used in the reaction solvates the ions formed in rate determining step.
(4) Br^- can act as competing nucleophile.

19. Match List I with List II

List I Vitamin	List II Deficiency disease
A. Vitamin A	I. Beri-Beri
B. Thiamine	II. Cheilosis
C. Ascorbic acid	III. Xeropthalmia
D. Riboflavin	IV. Scurvy

Choose the correct answer from the options given below:
(1) (A) – IV, (B) – II, (C) – III, (D) –I
(2) (A) – III, (B) – I, (C) – IV, (D) –II
(3) (A) – III, (B) – II, (C) – IV, (D) –I
(4) (A) – IV, (B) – I, (C) – III, (D) –II

20. Match list I with list II

List I Oxide	List II Type of bond
A. N_2O_4	I. 1 N = O bond
B. NO_2	II. 1 N – O – N bond
C. N_2O_5	III. 1 N – N bond
D. N_2O	IV. 1 N = N / N ≡ N bond

Choose the correct answer from the options given below:
(1) (A) – III, (B) – I, (C) – IV (D) –II
(2) (A) – II, (B) – IV, (C) – III (D) –I
(3) (A) – III, (B) – I, (C) – II (D) –IV
(4) (A) – II, (B) – I, (C) – III (D) –IV

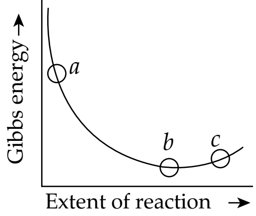
Section B

21. Number of bromo derivatives obtained on treating ethane with excess of Br_2 in diffused sunlight is ___________

22. For the adsorption of hydrogen on platinum, the activation energy is 30 k J mol^{-1} and for the adsorption of hydrogen on nickel, the activation energy is 41.4 kJ mol^{-1}. The logarithm of the ratio of the rates of chemisorption on equal areas of the metals at 300 K is ______(Nearest integer)

23. The number of species from the following which have square pyramidal structure is ________
PF_5, BrF_4^-, IF_5, BrF_5, $XeOF_4$, ICl_4^-

24. Consider the graph of Gibbs free energy G vs Extent of reaction. The number of statement/s from the following which are true with respect to points (a), (b) and (c) is __________



A. Reaction is spontaneous at (a) and (b)
B. Reaction is at equilibrium at point (b) and non-spontaneous at point (c)
C. Reaction is spontaneous at (a) and non-spontaneous at (c)
D. Reaction is non-spontaneous at (a) and (b)

25. In ammonium – phosphomolybdate, the oxidation state of Mo is + ______________

26. Number of ambidentate ligands in a representative metal complex $[M(en)(SCN)_4]$ is _____________
[en = ethylenediamine]

27. Mass of urea (NH_2CONH_2) required to be dissolved in 1000g of water in order to reduce the vapour pressure of water by 25% is ________g. (Nearest integer)
Given: Molar mass of N, C, O, and H are 14, 12, 16 and 1 g mol^{-1} respectively.

28. If 5 moles of $BaCl_2$ is mixed with 2 moles of Na_3PO_4, the maximum number of moles of $Ba_3(PO_4)_2$ formed is _______(Nearest integer)

29. The value of log K for the reaction $A \rightleftharpoons B$ at 298 K is _________(Nearest integer)

30. The wavelength of an electron of kinetic energy 4.50×10^{-29} J is _________$\times10^{-5}$ m. (Nearest integer)
Given: mass of electron is 9×10^{-31} kg, h = 6.6×10^{-34} J s.

Answer Key

Q. No.	Answer	Topic name	Chapter name
1	(1)	Polysaccharide	Biomolecules
2	(3)	Electrode Potential	Redox and electrode chemistry
3	(2)	Preparations of Amines	Compounds containing N
4	(3)	Solid State	States of Matter
5	(1)	Chemical Properties	Compounds containing N
6	(3)	VBT	Coordination Compounds
7	(4)	Aldehyde, Ketones and Carboxylic Acids	Organic Compounds Containing Oxygen
8	(2)	Copolymerization	Polymers

9	**(3)**	Redox Reactions	Redox Reaction and Electrochemistry
10	**(3)**	Properties of H	Hydrogen
11	**(2)**	Degree of dissociation	Equilibrium
12	**(2)**	Cement	S-block element
13	**(4)**	Electron gain enthalpies	Classification of Elements and Periodicity in Properties
14	**(2)**	Lanthanoides	d and f Block Elements
15	**(4)**	Separation of Organic Compounds	Practical Organic Chemistry
16	**(1)**	Detection of N, S, P and Halogens	Purification and characterization of Organic Compounds
17	**(3)**	Photochemical smog	Environmental Chemistry
18	**(2)**	Mechanism of Nucleophile Substitution Reaction	Organic Compounds Containing Halogens
19	**(2)**	Vitamins	Biomolecules
20	**(3)**	Group-15	p-block Elements
21	**[9]**	Preparation of Halo alkane	Organic Compounds Halogen
22	**[2]**	Arrhenius Equation	Chemical Kinetics
23	**[1]**	Concept of Hybridization	Chemical Bonding and Molecular Structure
24	**[1]**	Gibb's Free Energy	Thermodynamics
25	**[6]**	Oxidation Reaction	Redox Reactions
26	**[4]**	Ambidentate Ligands	Coordination Compounds
27	**[1111]**	Relative lowering of Vapous pressure	Solutions
28	**[3]**	Stoichiometry	Basic Concepts of Chemistry
29	**[10]**	Gibb's free energy	Equilibrium
30	**[7]**	De-Broglie Wavelength	Atomic structure

Solutions

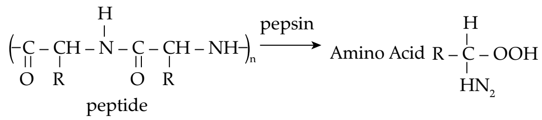
Section A

1. Option (1) is correct.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} \xrightarrow{\textit{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{glucose}}{C_6H_{12}O_6} \xrightarrow{\textit{Invertase}} \underset{\text{Ethyl alcohol}}{C_2H_5OH} + \underset{\text{carbon dioxide}}{CO_2}$$

$$\underset{\text{starch}}{2(C_6H_{10}O_5)} + nH_2O \xrightarrow{\text{Diastase}} \underset{\text{maltose}}{nC_{12}H_{22}O_{11}}$$



peptide

2. Option (3) is correct.

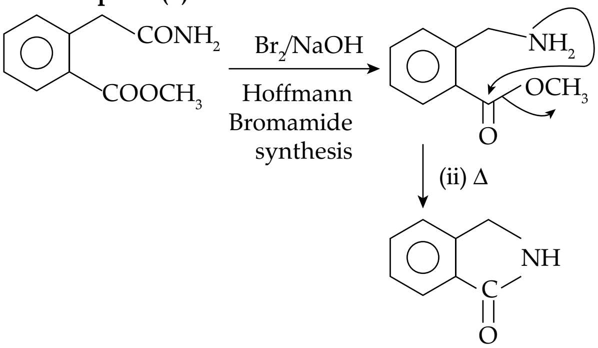
The standard potential in aqueous solution depends on the given factors

(i) The hydration of a gaseous atom.

(ii) Ionization of gaseous metal atom

(iii) Sublimation of a solid metal

3. Option (2) is correct.



4. Option (3) is correct.

Given, An element Y forms cubic close packed arrangement so its atom would occupy the corners and the face of the lattice.

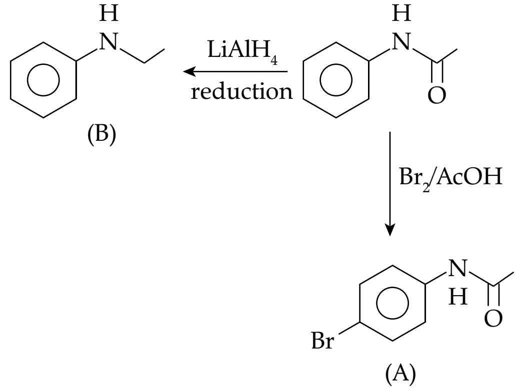
$$\therefore \text{No. of Y atoms} = \left(\frac{1}{8}\times 8\right) + \left(\frac{1}{2}\times 6\right) = 4$$

No. of tetrahedral voids = 8

No. of X atoms $= \frac{1}{3}\times 8 = \frac{8}{3}$

Formula $X_{8/3}\,Y_4 = X_2Y_3$

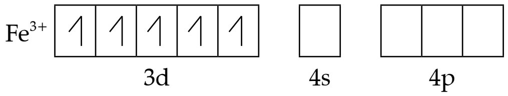
5. Option (1) is correct.



6. Option (3) is correct.

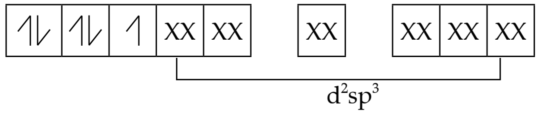
The oxidation state of Fe on both the complexes would be +3

In $[Fe(CN)_6]^{3-}$ The electronic configuration of Fe is $3d^6 4s^2$



CN^- is a strong ligands will pair up the electrons

$[Fe(CN)_6]^{3-}$



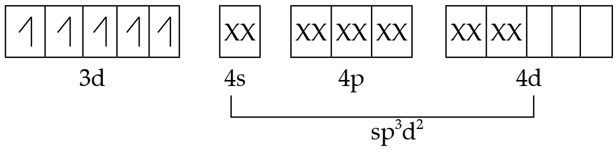
No. of unpaired electrons =1

$\mu = \sqrt{n(n+2)} = \sqrt{1\times(1+2)} = \sqrt{3} = 1.74\text{m}$

In $[Fe(H_2O)_6]^{3+}$

As H_2O is a weak ligand it will not pair up e^-s.

$[Fe(H_2O)]^{3+}$



No. of unpaired electron = 5

$\mu = \sqrt{5(5+2)} = \sqrt{35} = 5.92$ BM

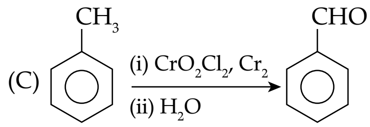
7. Option (4) is correct.

(A) $CH_3-\underset{\underset{O}{\|}}{C}OH \xrightarrow[H_2O]{Br_2/Red} \underset{\underset{Cl}{|}}{C}H_2-\underset{\underset{O}{\|}}{C}OH$

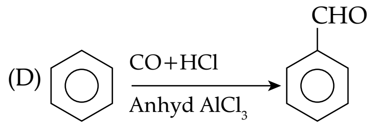
This reaction is Hell-volhard reaction.

(B) $CH_3-\underset{\underset{O}{\|}}{C}H \xrightarrow{NaOH+I_2} \underset{\text{Iodoform}}{CHI_3} + HCOO^-Na$

This reaction is iodoform reaction.



This reaction is Etard reaction.



This is Gattermann Koch Reaction.

8. Option (2) is correct.

Polymer that is used in the manufacture in orlon is polyacrylonitrile.

$$\underset{\text{Vinyl cyanide}}{n(CH_2=CH-CN)} \xrightarrow{\text{polymerization}} \underset{\text{polyacrylonitrile}}{\left(CH_2-\underset{\underset{CN}{|}}{CH}\right)_n}$$

9. Option (3) is correct.

$$\overset{+}{2[Au(CN)_2]}\,\overset{-}{}(aq) + \overset{0}{Zn}(s) \longrightarrow \overset{0}{2Au}(s) + [\overset{+2}{Zn}(CN)_2]^{2-}(aq)$$

oxidation

reduction

Since both oxidation and reduction take place simultaneously. So, it is a redox reaction. Also Zn is displacing Au from its salt solution. This is also a displacement reaction.

10. Option (3) is correct.

Loss of the electron from H atom results in nucleus of 1.5×10^{-3} pm size. As a consequence of its extremely small size, it always exist in combined state.

11. Option (2) is correct.

$A_2B_3 \rightleftharpoons 2A^+ + 3B^-$

C-Cα 2Cα 3Cα

$$K_{eq} = \frac{[A^+]^2[B^-]^3}{[A_2B_3]} = \frac{[2C\alpha]^2[3C\alpha]^3}{[C\text{-}C\alpha]} = \frac{108C^5\alpha^5}{C(1-\alpha)}$$

$$\therefore \frac{108C^5\alpha^5}{C} \quad \text{(For dilute solution } 1>>\alpha)$$

$$K_{eq} = 108C^4\alpha^5,\quad \alpha = \left(\frac{K_{eq}}{108C^4}\right)^{1/5}$$

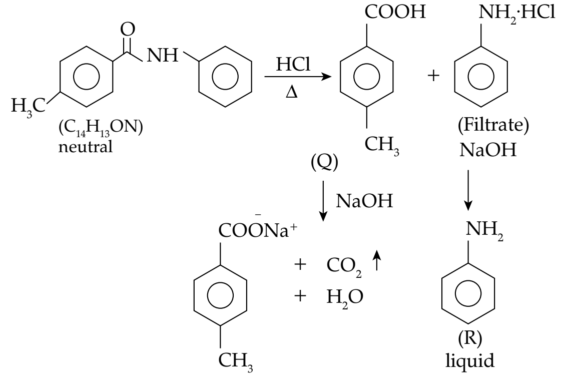
12. Option (2) is correct.

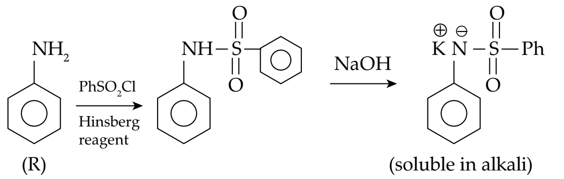
The setting time of cement can be increased by adding gypsum. It is hydrated calcium sulphate ($CaSO_4.2H_2O$).Cement manufacturing requires about 2-3% of gypsum.

13. Option (4) is correct.

The difference between electron gain enthalpies will be maximum between Ne and Cl. This is because chlorine has the highest electron gain enthalpy and neon being inert gas, will have least electron enthalpy.

15. Option (4) is correct.





16. Option (1) is correct.

Nitrogen can be detected by lassaigne's method where the product formed is Prussian blue in color.

$$Na_4[Fe(CN)_6]+Fe^{3+} \rightarrow \underset{\text{Prussian Blue}}{Fe_4[Fe(CN)_6]_3}$$

Sulphur is detected by sodium nitroprusside reagent.

$$Na_2[Fe(CN)_5NO]+Na_2S \rightarrow \underset{\text{purple}}{Na_4[Fe(CN)_5NOS]}$$

Phosphorus is detected by ammonium molybdate

$$PO_4^{3-}+3NH_4^{+}+12MoO_4^{2-}+24H^{+} \rightarrow \underset{\text{canary yellow ppt.}}{(NH_4)_3PO_4.12MoO_3}+12H_2O$$

Halogen can be detected by $AgNO_3$

$$Ag^{+}+X^{-} \rightarrow \underset{\text{white ppt}}{AgX}$$

Here, $X \neq F$

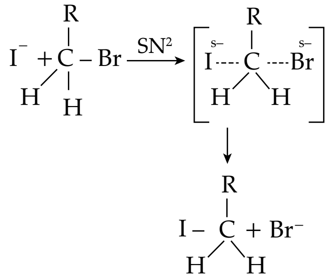
17. Option (3) is correct.

Photochemical smog also known as summer smog occurs in warm, dry and sunny climate. It is produced when ultraviolet light from sum reacts with oxides of nitrogen in the atmosphere. These oxides of nitrogen are mainly produced by industries such as automobiles.

18. Option (2) is correct.

$$RCH_2Br+I^{-} \xrightarrow{\text{Acetone}} RCH_2I+Br^{-}$$

The above reaction is an halogen exchange reaction which occurs via SN^2 mechanism as there is a primary halide (RCH_2Br). Thus, the transition state is formed in this reaction is less polar than the localized anion. It is a single step reaction which thus there will be no RDS. Also I^{-} is a better nucleophile than Br^{-}.



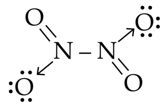
19. Option (2) is correct.

Deficiency of vitamin A causes xerophthalmia. Deficiency of thiamine causes Beri-Beri whereas scurvy is caused by deficiency of ascorbic acid, Riboflavin which is vitamin B_{12} deficiency causes calories.

20. Option (3) is correct.

The structures of the given molecules are as following:

N_2O_4

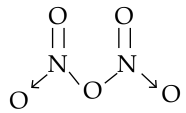


It has 2N=O, 2N-O and / 1N-N

NO_2 $\quad \ddot{O}=\dot{N}\rightarrow\ddot{O}:$

It has 1N=O and 1N-O bond

N_2O_5



It has 2N=O, 2N-O and 1N-O-N bond .

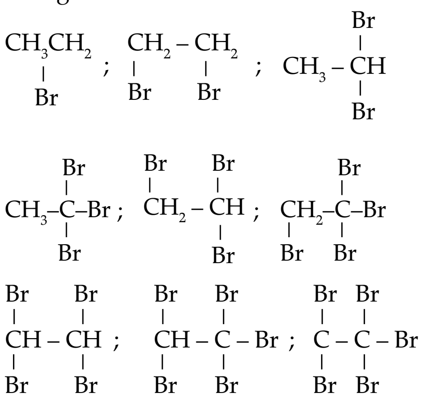
N_2O $\quad :\ddot{O}-N\equiv N \longleftrightarrow \ddot{O}=\overset{+}{N}=\overset{-}{N}$

It shows both N≡N as well as N=N in its resonating structures.

Section B

21. Correct answer is [9].

Different bromo derivatives that are obtained on treating ethane with excess of Br_2 in diffused sunlight is



22. Correct answer is [2].

From Arrhenius Equation.

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

The Arrhenius equation for adsorption of hydrogen on platinum will be

$$K_1 = Ae^{-Ea_1/RT} \quad \text{... (i)}$$

The Arrhenius equation for adsorption of hydrogen on Nickel will be

$$K_2 = Ae^{-Ea_2/RT} \quad \text{... (ii)}$$

Dividing the above equation

$$\frac{K_1}{K_2} = e^{1/RT(Ea_2 - Ea_1)}$$

Taking log on both sides

$$\log\frac{K_1}{K_2} = \frac{1}{2.303RT}[Ea_2 - Ea_1]$$

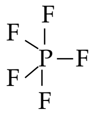
$$\log\frac{K_1}{K_2} = \frac{1}{2.303 \times 8.314 \times 300}[(4.14 - 30) \times 10^3]$$

$$\log\frac{K_1}{K_2} = 1.99 \approx 2$$

23. Correct answer is [1].

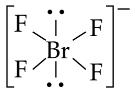
The structures of given molecules are as follows:

PF_5



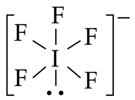
Trigonal bipyramidal (sp^3d^2+0lp)

BrF_4^-



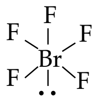
Square planar (sp^3d^2+2lp)

IF_5



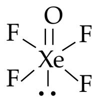
Square pyramidal (sp^3d^2+1lp)

BrF_5



Square pyramidal.(sp^3d^2+1lp)

$XeOF_4$



Square pyramidal (sp^3d^2+1lp)

24. Correct answer is [1].

As the value of ΔG is decreasing at a point a i.e. it has a negative value, so the reaction would be spontaneous. At point c, the of ΔG is increasing at C i.e. it has a positive value, then the reaction is non spontaneous.

25. Correct answer is [6].

The formula for ammonium phosphomolybdate is $(NH_4)_3PMo_{12}O_{40}$

Let the oxidation of Mo be x.

$\therefore 3(+1) + 1(+5) + 12(x) + 40(-2) = 0$

$$12x = 72$$

$$x = +6$$

26. Correct answer is [4].

Ambident ligands are those ligands which have two ligating sites but at a time only one of the ligand can form a bond with metal.

In the given SCN^- is an ambident nucleophile. Thus number of ambident ligands in $[M(en)(SCN)_4]$ are four.

27. Correct answer is [1111].

Let the given mass of urea be m molecular mass of urea (NH_2CONH_2)

$$= 14 \times 2 + 1 \times 4 + 1 \times 12 + 1 \times 16 = 60$$

The relative lowering of vapour pressure is given by

$$\frac{P^0 - Ps}{P^0} = x_{solute}$$

$$\frac{25}{100} = \frac{n_{urea}}{n_{urea} + n_{H_2O}} \Rightarrow \frac{25}{100} = \frac{m/60}{\frac{m}{60} + \frac{1000}{18}}$$

$$\frac{4m}{60} = \frac{m}{60} + \frac{1000}{18} \Rightarrow m = \frac{1000 \times 20}{18} = 1111.11 \approx 1111$$

28. Correct answer is [3.33].

The reaction between $BaCl_2$ with Na_3PO_4 is given as :

$$3BaCl_2 + 2Na_3PO_4 \rightarrow Ba_3(PO_4)_2 + 6NaCl$$

In this reaction 3 moles of $BaCl_2$ reacts with 2 moles of Na_3PO_4

Hence 5 moles of $BaCl_2$ will require

$$= \frac{2}{3} \times 5 = 3.33 \text{ moles of } Na_3PO_4$$

29. Correct answer is [10].

We know that

$$\Delta G° = \Delta H° - T\Delta S°$$

$$= 54.07 - 298 \times 10 \times 10^{-3}$$

$$= -57.05 \text{ KJ/mole or } 57050\text{J}$$

Also, $\Delta G° = -RT\ln K = -2.303RT \log K$

$$57050 = -2.303 \times 8.314 \times 298 \log K$$

$$10 = \log K$$

30. Correct answer is [7].

Given kinetic energy = 4.50×10^{-29}J

$$\lambda = \frac{h}{\sqrt{2mKE}} = \frac{6.6 \times 10^{-34}}{\sqrt{2 \times 9 \times 10^{-31} \times 4.50 \times 10^{-29}}}$$

$$= \frac{6.6 \times 10^{-34}}{9 \times 10^{-30}} \approx 7 \times 10^{-5}\text{ m}$$

❑❑