JEE (Main) CHEMISTRY SOLVED PAPER

2023

08th April Shift 1

Section A

1. The reaction

$$\frac{1}{2}H_2(g)+AgCl(s) \rightleftharpoons H^+(aq)+Cl^-(aq)+Ag(s)$$

Occurs in which of the given galvanic cell.

(1) Pt $|H_2(g)|HCl(sol^n)|AgNO_3(sol^n)|Ag$

(2) Pt $|H_2(g)|HCl(sol^n)|AgCl(s)|Ag$

(2) Pt $|H_2(g)|KCl(sol^n)|AgCl(s)|Ag$

(4) Ag $|AgCl(s)|KCl(sol^n)|AgNO_3|Ag$

2. Sulphur (S) containing amino acids from the following are:

(a) isoleucine, (b) cysteine, (c) lysine, (d) methionine and (e) glutamic acid

(1) b, c, e **(2)** a, d **(3)** a, b, c **(4)** b, d

3. Which of the following complex is octahedral, diamagnetic and the most stable?

(1) $K_3[Co(CN)_6]$ **(2)** $[Ni(NH_3)_6]Cl_2$

(3) $[Co(H_2O)_6]Cl_2$ **(4)** $Na_3[CoCl_6]$

4. Which of the following metals can be extracted through alkali leaching technique?

(1) Cu **(2)** Au **(3)** Pb **(4)** Sn

5. The correct order of spin only magnetic moments for the following complex ions is

(1) $[CoF_6]^{3-}<[MnBr_4]^{2-}<[Fe(CN)_6]^{3-}<[Mn(CN)_6]^{3-}$

(2) $[Fe(CN)_6]^{3-}<[CoF_6]^{3-}<[MnBr_4]^{2-}<[Mn(CN)_6]^{3-}$

(3) $[MnBr_4]^{2-}<[CoF_6]^{3-}<[Fe(CN)_6]^{2-}<[Mn(CN)_6]^{3-}$

(4) $[Fe(CN)_6]^{3-}<[Mn(CN)_6]^{3}<[CoF_6]^{3-}<[MnBr_4]^{2-}$

6. The water gas on reacting with cobalt as a catalyst forms

(1) Methanoic acid **(2)** Methanal

(3) Ethanol **(4)** Methanol

7. $2IO_3^- + xI^- + 12H^+ \rightarrow 6I_2 + 6H_2O$

What is the value of x?

(1) 12 **(2)** 10

(3) 2 **(4)** 6

8. What is the purpose of adding gypsum to cement?

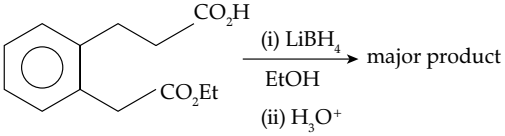
(1) To give a hard mass

(2) To speed up the process of setting

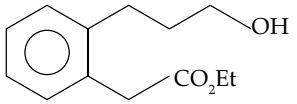
(3) To facilitate the hydration of cement

(4) To slow down the process of setting

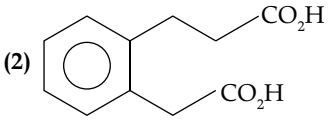
9. The major product formed in the following reaction is:



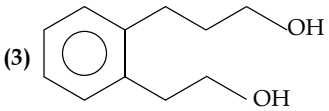
(1)



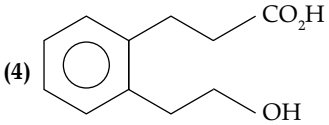
(2)



(3)



(4)



10. Match list I with list II:

List I (species)	List II (Maximum allowed concentration in ppm in drinking water)
A. F^-	I. <50 ppm
B. SO_4^{2-}	II. <5 ppm
C. NO_3^-	III. <2 ppm
D. Zn	IV. <500 ppm

(1) A-III, B-II, C-I, D-IV **(2)** A-II, B-I, C-III, D-IV

(3) A-IV, B-III, C-II, D-I **(4)** A-I, B-II, C-III, D-IV

11. In chromyl chloride, the number of d-electrons present on chromium is same as in (Given at no. of Ti: 22, V : 23, Cr : 24, Mn : 25, Fe : 26)

(1) Fe (III) **(2)** V (IV) **(3)** Ti (III) **(4)** Mn (VII)

12. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Butan-1-ol has higher boiling point than ethoxyethane.

Reason R: Extensive hydrogen bonding leads to stronger association of molecules.

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

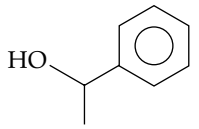
(1) Both A and R are true but R is not the correct explanation of A

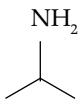
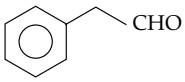
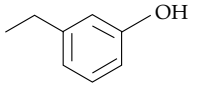
(2) Both A and R are true and R is the correct explanation of A

(3) A is false but R is true

(4) A is true but R is false

13. Match List I with List II:

List I (Reagents used)	List II (Compound with Functional group detected)
A. Alkaline solution of copper sulphate and sodium citrate	I. 

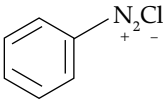
B. Neutral $FeCl_3$ solution	II. 
C. Alkaline chloroform solution	III. 
D. Potassium iodide and sodium hypochloride	IV. 

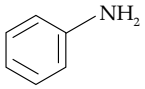
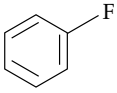
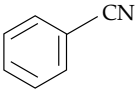
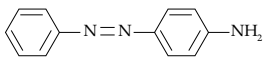
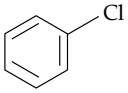
Choose the correct answer from the options given below:

(1) A-III, B-IV, C-II, D-I **(2)** A-II, B-IV, C-III, D-I

(3) A-IV, B-I, C-II, D-III **(4)** A-III, B-IV, C-I, D-II

14. Match List I with List II:

 is reacted with reagents in List I to form products in List II.

List I (Reagent)	List II (Product)
A. 	I. 
B. HBF_4, Δ	II. 
C. Cu, HCl	III. 
D. CuCN/KCN	IV. 

Choose the correct answer from the options given below:

(1) A-I, B-III, C-IV, D-II **(2)** A-III, B-I, C-II, D-IV

(3) A-III, B-I, C-IV, D-II **(4)** A-IV, B-III, C-II, D-I

15. Match List I with List II:

List I	List II
A. Saccharin	I. High potency sweetener
B. Aspartame	II. First artificial sweetening agent
C. Alitame	III. Stable at cooking temperature
D. Sucralose	IV. Unstable at cooking temperature

Choose the correct answer from the options given below:

(1) A-II, B-III, C-IV, D-I **(2)** A-II, B-IV, C-I, D-III

(3) A-IV, B-III, C-I, D-II **(4)** A-II, B-IV, C-III, D-I

16. The correct order of electronegativity for given elements is:

(1) P > Br > C > At **(2)** C > P > At > Br

(3) Br > P > At > C **(4)** Br > C > At > P

17. Given below are two statements:

Statement I: Lithium and Magnesium do not form superoxide.

Statement II: The ionic radius of Li^+ is larger than ionic radius of Mg^{2+}.

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

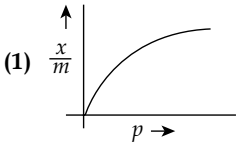
(1) Statement I is correct but Statement II is incorrect

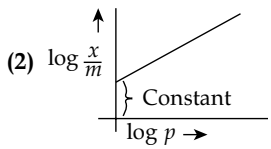
(2) Statement I is incorrect but Statement II is correct

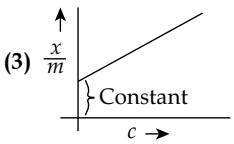
(3) Both statement I and Statement II are correct

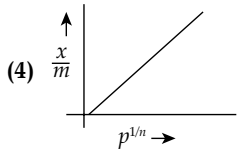
(4) Both statement I and Statement II are incorrect

18. Which of the following represent the Freundlich adsorption isotherms?

(1) 

(2) 

(3) 

(4) 

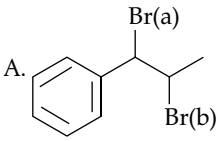
19. Which halogen is known to cause the reaction given below:

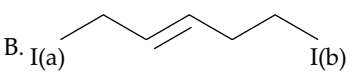
$2Cu^{2+} + 4X^- \rightarrow Cu_2X_2(s) + X_2$

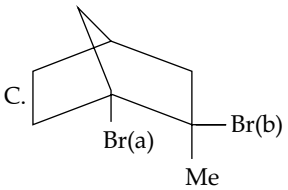
(1) All halogens **(2)** Only chlorine

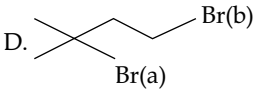
(3) Only Bromine **(4)** Only Iodine

20. Choose the halogen which is most reactive towards S_N1 reaction in the given compounds (A, B, C, & D)

A. 

B. 

C. 

D. 

(1) A-Br(a) ; B-I(a) ; C-Br(b) ; D-Br(a)

(2) A-Br(b) ; B-I(a) ; C-Br(a) ; D-Br(a)

(3) A-Br(b) ; B-I(b) ; C-Br(b) ; D-Br(b)

(4) A-Br(a) ; B-I(a) ; C-Br(a) ; D-Br(a)

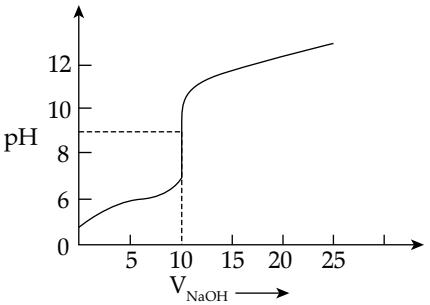
Section B

21. Molar mass of the hydrocarbon (X) which on ozonolysis consumes one mole of O_3 per mole of (X) and gives one mole each of ethanal and propanone is _____g mol^{-1} (Molar mass of C : 12 g mol^{-1}, H : 1 $gmol^{-1}$)

22. XeF_4 reacts with SbF_5 to form $[XeF_m]^{n+}[SbF_y]^{z-}$
$m + n + y + z =$_____

23. The number of following statements which is/are incorrect is_____
(1) Line emission spectra are used to study the electronic structure.
(2) The emission spectra of atoms in the gas phase show a continuous spread of wavelength from red to violet.
(3) An absorption spectrum is like the photographic negative of an emission spectrum.
(4) The element helium was discovered in the sun by spectroscopic method.

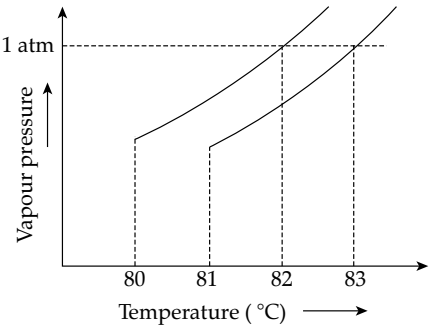
24. The titration curve of a weak acid vs. strong base with phenolphthalein as indictor is shown below. The $K_{phenolphthalein} = 4 \times 10^{-10}$
Given: log 2 = 0.3



The number of following statement/s which is/are correct about phenolphthalein is_____
(1) It can be used as an indicator for the titration of weak acid with weak base.
(2) It begins to change colour at pH = 8.4
(3) It is a weak organic base
(4) It is colourless in acidic medium

25. When a 60 W electric heater is immersed in a gas for 100s in a constant volume container with adiabatic walls, the temperature of the gas rises by 5°C. The heat capacity of the given gas is_____J K^{-1}(Nearest integer).

26. The vapour pressure vs. temperature curve for a solution solvent system is shown below:

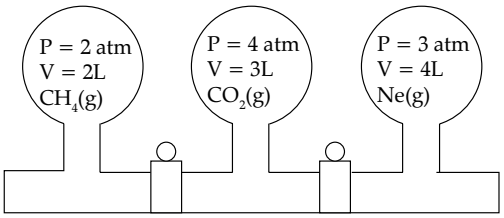


The boiling point of the solvent is_____°C

27. 0.5 g of an organic compound (X) with 60% carbon will produce_____$\times 10^{-1}$ g of CO_2 on complete combustion.

28. The number of following factors which affect the percent covalent character of the ionic bond is_____
(1) Polarising power of cation
(2) Extent of distortion of anion
(3) Polarisability of the anion
(4) Polarising power of anion

29.



Three bulbs are filled with CH_4, CO_2 and Ne as shown the picture. The bulbs are connected through pipes of zero volume. When the stopcocks are opened and the temperature is kept constant throughout, the pressure of the system is found to be_____atm. (Nearest integer)

30. The number of given statement/s which is/are correct is_____
(1) The stronger the temperature dependence of the rate constant, the higher is the activation energy.
(2) If a reaction has zero activation energy, its rate is independent of temperature.
(3) The stronger the temperature dependence of the rate constant, the smaller is the activation energy
(4) If there is no correlation between the temperature and the rate constant then it means that the reaction has negative activation energy.

Answer Key

Q. No.	Answer	Topic name	Chapter name
1	(2)	Electrochemical Cell	Electrochemistry
2	(4)	Proteins and Polysaccharide	Biomolecules
3	(1)	Crystal Field Theory	Coordination Compounds
4	(4)	Concentration of Ores	General Principles and Processes of Isolation of Elements
5	(4)	Crystal Field Theory	Coordination Compounds

6	**(4)**	Catalysis	Surface Chemistry
7	**(2)**	Applications of Oxidation Number	Redox Reaction
8	**(4)**	Some Important Compounds of Calcium	S-Block Elements
9	**(4)**	Reactions of Carboxylic Acid	Aldehydes, Ketones & Carboxylic Acids
10	**(1)**	Water Pollution	Environmental Chemistry
11	**(4)**	Some Transition Elements	d & f Block Elements
12	**(2)**	Physical Properties	Alcohols, Phenols & Ethers
13	**(1)**	Detection of Functional Group	Salt Analysis
14	**(3)**	Naming Reaction	Nitrogen Containing Compounds
15	**(2)**	Chemicals in Food	Chemistry In Everyday Life
16	**(4)**	Trends in Physical Properties	Classification of Elements and Periodicity in Properties
17	**(3)**	Trends in Physical Properties	Classification of Elements and Periodicity in Properties
18	**(BONUS)**	Freundlich Isothermal	Surface Chemistry
19	**(4)**	Some Transition Elements	d & f Block Elements
20	**(1)**	Fundamental Concepts in Organic Reaction Mechanism	Organic Chemistry - Some Basic Principles and Techniques
21	**[70]**	Law of Chemical Combinations	Some Basic Concepts of Chemistry
22	**[11]**	Some Transition Elements	d & f Block Elements
23	**[1]**	Evidence for Quantized Electronic Energy Levels	Atomic Structure
24	**[2]**	Hydrolysis of Salts and the pH of their Solutions	Ionic Equilibrium
25	**[1200]**	Adiabatic	Thermodynamics
26	**[82]**	Vapour Pressure of Solutions of Liquids in Liquids	Solutions
27	**[11]**	Stoichiometry	Some Basic Concepts of Chemistry
28	**[3]**	Ionic And Electrovalent Bond	Chemical Bonding & Molecular Structure
29	**[3]**	Ideal Gas Equation	States of Matter
30	**[2]**	Effect of Temperature and Catalyst on Rate of a Reaction	Chemical Kinetics

Solutions

Section A

1. Option (2) is correct.

H_2 gets oxidised to HCl in the galvanic cell.

Pt, H_2 |HCl(*sol*) forms anode.

AgCl(*s*)|Ag forms cathode.

$\therefore$ The cell can be written as

Pt,$H_2(g)$|HCl(*sol*)||AgCl(*s*)|Ag

2. Option (4) is correct.

Isoleucine is an α-amino acid that is used in the biosynthesis of proteins. It contains an α amino group, an α-carboxylic acid group, and a hydrocarbon side chain with a branch. It is classified as a non-polar, uncharged, branched-chain, aliphatic amino acid.

Lysine is an α-amino acid that is a precursor to many proteins. It contains an α-amino group, an alpha-carboxylic acid group, and a side chain lysyl, classifying it as a basic, charged, aliphatic amino acid. It is encoded by the codons AAA and AAG.

Glutamic acid is an amino acid used to form proteins.

Cysteine and methionine are sulphur containing amino acids. Amino acids get linked to one another by peptide bond formation and form a polypeptide chain of proteins. Hence cysteine and methionine are found in several proteins.

(a) isoleucine : $CH_3—CH_2—\underset{\displaystyle CH_3}{\underset{|}{CH}}—\underset{\displaystyle NH_2}{\underset{|}{CH}}—COOH$

(b) cysteine : $HS—CH_2—\underset{\displaystyle NH_2}{\underset{|}{CH}}—COOH$

(c) lysine : $H_2N-(CH_2)_4-\underset{\underset{NH_2}{|}}{CH}-COOH$

(d) methionine : $CH_3-S-CH_2-CH_2-\underset{\underset{NH_2}{|}}{CH}-COOH$

(e) glutamic acid : $HOOC-CH_2-CH_2-\underset{\underset{NH_2}{|}}{CH}-COOH$

3. Option (1) is correct.

$K_3[Co(CN)_6]^{3-}$ and $[Co(H_2O)_6]^{3+}$ are diamagnetic but first one is more stable as Δ_0 is high for first complex.

$K_3[Co(CN)_6]$

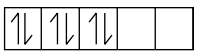
$+3 + x - 6 = 0$

$\boxed{x = +3}$

$\Downarrow$

$Co^{+3} \rightarrow 3d^6$

$\therefore CN^-$ is SFL so pairing occur so



$U_e = 0$

$\downarrow$

So diamagnetic in nature

4. Option (4) is correct.

Alkali-acid leaching is an effective method used to purify graphite and remove silicate minerals. In this study, the dissolution behavior and mechanism of sericite in alkali-acid leaching were investigated.

In this method, the ore is treated with aqueous alkali to form a soluble complex. For example, bauxite, an important ore of aluminium is heated with a solution of sodium hydroxide or sodium carbonate in the temperature range 470–520 K at 35 atm to form soluble sodium meta- aluminate leaving behind the impurities, iron oxide and titanium oxide.

$$Al_2O_3(s) + 2NaOH(aq) + 3H_2O(l) \rightarrow 2Na[Al(OH)_4](aq)$$

The hot solution is decanted, cooled, and diluted. This solution is neutralised by passing gas, to form hydrated Al_2O_3 precipitate.

$$2Na[Al(OH)_4](aq) + CO_2(g) \rightarrow Al_2O_3 \cdot xH_2O(s) + 2NaHCO_3(aq)$$

The precipitate is filtered off and heated around 1670K to get pure alumina Al_2O_3.

5. Option (4) is correct.

Br^- is a weak ligand while CN^- is a strong ligand. More the number of unpaired electrons, more the value of magnetic moment.

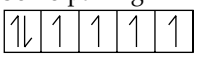
$[CoF_6]^{3-}$ | $[MnBr_4]^{2-}$

$\downarrow$ | $\downarrow$

Co^{+3} | Mn^{+2}

F^- is WFL | Br^- is WFL

So no pairing | no pairing



$U_e = 4$ | $U_e = 5$

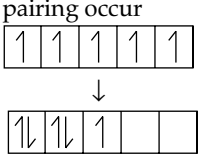
$[Fe(CN)_6]^{3-}$ | $[Mn(CN)_6]^{3-}$

$\downarrow$ | $\downarrow$

Fe^{3+} | Mn^{+3}

CN^- is SFL | CN^- is SFL

pairing occur | no pairing



$U_e = 1$ | $U_e = 2$

$[Fe(CN)_6]^{3-} < [Mn(CN)_6]^{3-} < [CoF_6]^{3-} < [MnBr_4]^{2-}$

6. Option (4) is correct.

Water gas shift reaction is defined as the reaction between carbon and water vapor to form carbon monoxide and hydrogen. The mixture of carbon monoxide and hydrogen is known as water gas. This reaction is more catalyzed on iron catalysts and merely catalyzed by cobalt catalysts. The chemical equation for the formation of water gas shift reaction follows:

$$C + H_2O \rightleftharpoons CO + H_2$$

$$(CO + H_2) + H_2 \xrightarrow[\underset{\text{Catalyst}}{ZnO, Cr_2O_3}]{700K} CH_3OH$$

7. Option (2) is correct.

Given reaction, $I_2 \rightarrow IO_3^- + I^-$

Disproportionation reaction is the reaction in which an element under go both oxidation and reduction.

$$\overset{(0)}{I_2} \rightarrow \overset{(+5)}{IO_3^-} + \overset{(-1)}{I^-}$$

I has oxidised from O to +5 and reduced from 0 to –1.

n factor of IO_3^- and I^- in the given redox reaction are 5 and 1 respectively. Therefore, will always react in the molar ratio 1 : 5 to get I_2 .

$$IO_3^- + 6H^+ + 5I^- \rightarrow 3I_2 + 3H_2O$$

To get 6 molar I_2, multiple equation by 2

$$2IO_3^- + 12H^+ + 10I^- \rightarrow 6I_2 + 6H_2O$$

So, $x = 10$

8. Option (4) is correct.

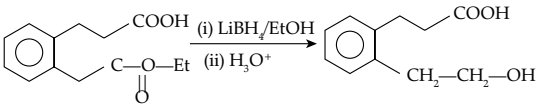
Gypsum ($CaSO_4.2H_2O$) plays an important role in controlling the rate of hardening of the cement. During cement manufacturing process upon

cooling of clinker a small amount of gypsum is added during the final grinding process. Gypsum controls the setting of the cement and if not added the cement will set immediately leaving no time for concrete placing.

9. Option (4) is correct.

$NaBH_4$ (Sodium borohydride) is a weak reducing agent, it reduces aldehydes / ketones but not esters, it produces alcohols through reduction.

Ketones reduces to 2° alcohol.



NOTE: Lithium borohydride is commonly used for selective reduction of esters and lactones to the corresponding alcohol.

10. Option (1) is correct.

NO_3^- The maximum limit of nitrate NO_3^- in drinking water is 50 ppm and its source is fertilisers, if the maximum limit is increased in water it will cause methemoglobinemia (blue baby syndrome SO_4^{2-}. The maximum limit of sulphate (SO_4^{2-}) according to WHO is 500 pm and its source are acid rain, industries. Excess SO_4^{2-} has laxative effect. F^- The maximum limit of fluoride (F^-) is about 1.5 ppm. Its higher concentration converts enamel to more harder fluorapatite. Concentration (>2ppm) causes brown mottling of teeth and high concentration (>10 ppm) are harmful for bones and teeth. SO_4^{2-} (100 ppm) and NO_3^- (50 ppm) in water is suitable for drinking but the concentration of F^- (10 ppm makes water unsuitable for drinking.

Zinc is one of the important trace elements that play a vital role in the physiological and metabolic process of many organisms. Nevertheless, higher concentrations of zinc can be toxic to the organism.

It plays an important role in protein synthesis and is a metal which shows fairly low concentration in surface water due to its restricted mobility from the place of rock weathering or from the natural sources.

According to the standards maximum prescribed limit of Zn in drinking water is 5 ppm.

11. Option (4) is correct.

When a mixture containing chloride ion is heated with $K_2Cr_2O_7$ and concentrated H_2SO_4, deep orange-red fumes of chromyl chloride (CrO_2Cl_2) are formed

$K_2Cr_2O_7 + 4NaCl + 6H_2SO_4 \rightarrow 2KHSO_4 + 4NaHSO_4 + 2CrO_2Cl_2 \uparrow + 3H_2O$

Orange-red fumes

So in this case, X in CrO_2Cl_2.

Oxidation state of Cl = –1, O = –2, Cr = x

$x + 2 \times (-2) + 2 \times (-1) = 0 \Rightarrow x = +6$

$CrO_2Cl_2 \rightarrow$ Chromyl chloride

$\Downarrow$

$Cr^{+6} \rightarrow 4s^0 3d^0$

$Mn(vii) \rightarrow Mn^{+7}$ — Same

$\Downarrow$

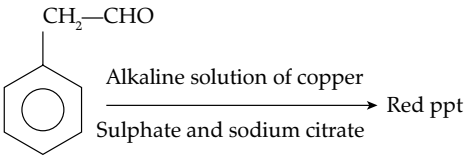
$4s^0 3d^0$

12. Option (2) is correct.

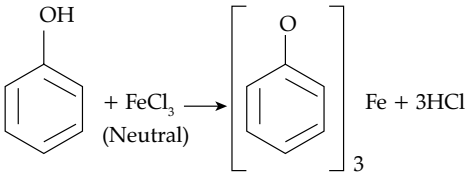
Both are functional isomers. However, intermolecular hydrogen bonding is present in butan-1-ol molecules while it is absent in the molecules of diethyl ether. Therefore, boiling point of alcohol (390 K) is higher as compared to that of ether (308 K).

13. Option (1) is correct.

(A) Fehling's solution is used to distinguish between aldehyde and ketone functional groups. Aldehydes oxidize to give a positive result but ketones won't react to the test (except for α-hydroxy ketones). Fehling's test is used as a general test for determining monosaccharides and other reducing sugars.



(B)



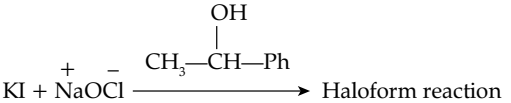
(C) This reaction is a chemical test for detection of primary amines, in which the amine is heated with alcoholic potassium hydroxide and chloroform. If a primary amine is present, the isocyanide is formed. The reaction is known as carbylamine reaction.

$RNH_2 + CHCl_3 + 3KOH \rightarrow RN^+ \equiv C^- + 3KCl + 3H_2O$

When a methyl ketone (even acetaldehyde) is reacted with halogen in aqueous sodium hydroxide, the ketone gets oxidised to the sodium salt of acid with one carbon less than ketone and at the same time haloform (CHX_3) also gets formed.

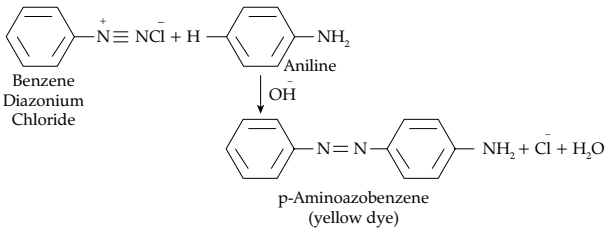
$2NaOH + X_2 \rightarrow \underset{\text{Sodium halide}}{NaX} + \underset{\text{Sodium hypohalite}}{NaOX}$

The hydroxide ion acts as a nucleophile and attacks the electrophilic carbon which is doubly bonded to oxygen. This carbon-oxygen double bond becomes a single bond making the oxygen atom anionic.

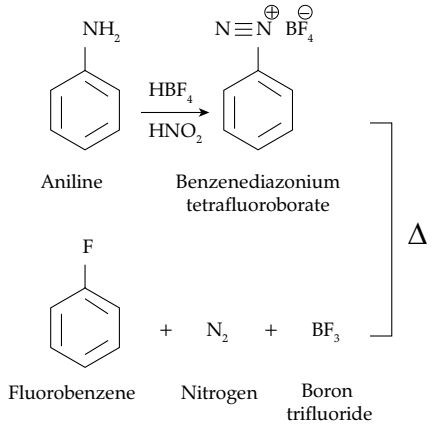


14. Option (3) is correct.

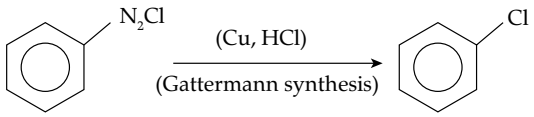
(A) Coupling Reaction:



(B) Balz–Schiemann reaction:



(C) Gattermann Reaction → In this reaction, chlorine or bromine can be introduced in the benzene ring by treating the benzene diazonium salt solution with corresponding halogen acid in the presence of copper powder.



(D) In the given reaction when benzene diazonium salt is treated with KCN and copper powder, it forms aryl nitrile or benzyl nitrile as a product.

15. Option (2) is correct.

A. Saccharin is first popular artificial sweetening agent. It is 550 times as sweet as cane sugar. It is used as intake by diabetic person.

B. Aspartame is 100 times as sweet as cane sugar. It is used in cold foods and soft drinks because it is unstable at cooking temperature.

C. Alitame is 2000 times as sweet compared to cane sugar. It has excellent stability at high temperature. So, can be used in cooking and baking.

D. Sucralose is 600 times as sweet as cane sugar. It is heat stable and finds its use in baked goods.

16. Option (4) is correct.

Electronegativity is a measure of an atom's ability to attract shared electrons to itself. On the periodic table, electronegativity generally increases as we move from left to right across a period due to increase in effective nuclear charge.

C (2.5)
P (2.1) $\Rightarrow$ Br > C > At > P
Br (2.8)
At (2.2)

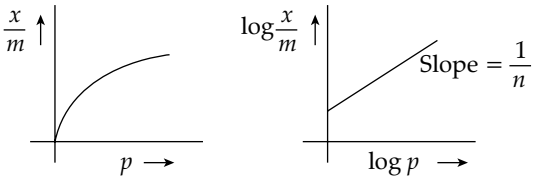
17. Option (3) is correct.

Lithium and Magnesium does not form superoxides because they are very small in size.

18. Option (1 & 2) is correct.

The equation $\frac{x}{m} = kp^{1/n}$ represents Freundlich adsorption isotherm. It is an empirical relationship between the amount of gas adsorbed by a given amount of solid adsorbent surface and pressure of the gas at a particular temperature.

$\frac{x}{m} = kp^{1/n}$ $\qquad$ $\log\frac{x}{m} = \log K + \frac{1}{n}\log p$



19. Option (4) is correct.

2Cu^{+2} + $4X_2 \rightarrow Cu_2X_2 + X_2$ and the same applies to CuX. On the other hand, all Cu(II) halides are known except the iodide. In this case, Cu^{2+} oxidises I^- to I_2:

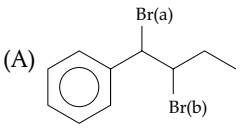
$2Cu^{2+} + 4I^- \rightarrow Cu_2I_2(s) + I_2$

However, many copper (I) compounds are unstable in aqueous solution and undergo disproportionation.

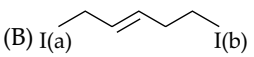
$2Cu^+ \rightarrow Cu^{2+} + Cu$

20. Option (1) is correct.

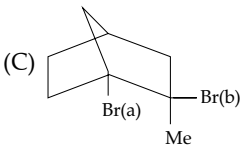
Organic compounds are more reactive towards SN 1, if the carbocation is stable compared to others. Reactivity in reactions depends upon the stability of the carbocation intermediate.

(A) 

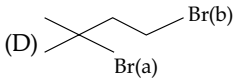
→ Br(a), Becuase formed intermediate carbocation get stable by conjugation with phenyl ring

(B) 

→ I(a), Becuase formed intermediate carbocation become more stable by conjugation

(C) 

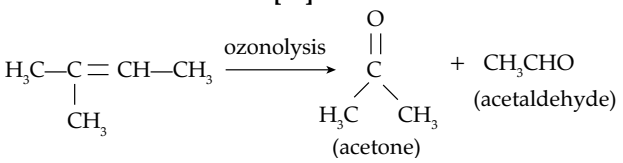
→ Br(b), Becuase we can't remove Br(a) from bridge head carbon (Bredt's rule

(D) 

→ Br(a), because formed intermediate 3° carbocation is more stable (stability of carbocation 3° > 2° > 1°)

Section B

21. Correct answer is [70].



Hydrocarbon (X) is 2-methyl- but-2-ene (C_5H_{10})
And the molecular mass is 5 (12) + 10 (1) = 70.

22. Correct answer is [11].

XeF_4 reacts with SbF_5 which is a lewis acid and forms adduct. The reaction is

$XeF_4 + SbF_5 \; [XeF_3]^+[SbF_6]^-$

The cation is T-shaped and the anion is octahedral.

$m + n + x + y = 3 + 1 + 6 + 1 = 11$

Xenon fluoride act as F^- donor.

23. Correct answer is [1].

The emission spectra of atoms in the gaseous phase do not show a continuous spread of wavelength from red to violet, rather they emit light only at specific wavelengths with dark spaces between them.

24. Correct answer is [2].

Phenolphthalein is used as an indicator in titrations involving weak acids and strong bases because it changes color at the point of neutralization. At a pH of 8.2-9.8, phenolphthalein is colorless, but at a pH above 10, it becomes pink. This change in color allows for a visual indication of neutralisation. acid and base. Additionally, phenolphthalein has a relatively low detection limit, making it useful for determining the end point of a titration accurately.

25. Correct answer is [1200].

Adiabatic wall {no heat exchange between system and surrounding}

$Cv \times \Delta T = E \times t$

$Cv \times 5 = 60 \times 100$

$Cv = 1200$

26. Correct answer is [82].

At any temperature, the vapour pressure of the solution is lower than that of the pure solvent. Hence vapour pressure- temperature curve of solution lies below that of solvent.

The more volatile liquid evaporates fast as compared to the less volatile liquid at a low temperature because the volume increases with respect to temperature so it has a low boiling point.

27. Correct answer is [11].

Mass of Carbon = 12

Molar Mass of $CO_2 = 12 + (16 \times 2) = 44$

Mass of Compound = 0.5 g

$$\% \text{ of C} = \frac{\text{Molar mass of C} \times \text{Mass Of } CO_2}{\text{Mass Of Compound} \times \text{Molar Mass Of } CO_2}$$

$$\frac{60}{100} = \frac{12 \times x}{0.5 \times 44}$$

$1.1 = x$

$x = 11 \times 10^{-1}$

28. Correct answer is [3].

Percent covalent character of the ionic bond depends upon

(1) Polarising power of cation

(2) Extent of distortion of anion

(3) Polarisability of the anion

Every ionic compound having some percentage of covalent character according to Fajan's rule. The percentage of ionic character in a compound having covalent character, can also be calculated by the following equation.

The percent ionic character

$$= \frac{\text{observed dipole moment}}{\text{Calculated dipole moment assuming 100\% ionic bond}} \times 100$$

29. Correct answer is [3].

Dalton's law of partial pressure states that whenever two or more gases, which do not react chemically, are enclosed in vessel, the total pressure is equal to sum of partial pressure of each gas.

From Dalton's partial pressure law,

$P_f V_f = P_1 V_1 + P_2 V_2 + P_3 V_3$

$P_f \times 9 = 2 \times 2 + 4 \times 3 + 3 \times 4$

$$P_f = \frac{28}{9} = 3.11 = 3$$

30. Correct answer is [2].

Clearly, if $E_a = 0$, K is temperature independent

if $E_a > 0$, K increase with increase in temperature

if $E_a < 0$, K decrease with increase in temperature

- Rate constant increases with increase in temperature. This is due to a greater number of collisions whose energy exceeds the activation energy.
- Higher the magnitude of activation energy, stronger is the temperature dependence of the rate constant.
- The pre-exponential factor is a measure of the rate at which collisions occur, irrespective of their energy.
  a. A high activation energy usually implies a slow reaction.
  b. $k = P \times Z \times e^{-E_a/RT}$
  c. The pre-exponential factor (A = P×Z) is independent of the activation energy and the energy of molecules.

❑❑