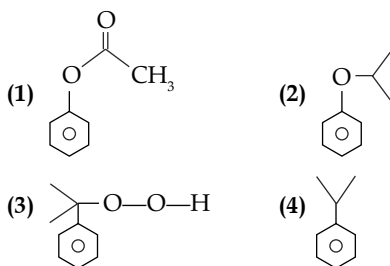


JEE (Main) CHEMISTRY SOLVED PAPER

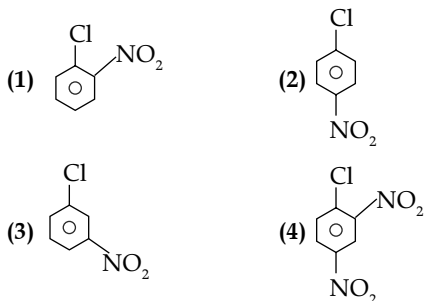
2023
25th Jan. Shift 1

Section A

Q. 1. In the cumene to phenol preparation in presence of air, the intermediate is



Q. 2. The compound which will have the lowest rate towards nucleophilic aromatic substitution on treatment with OH⁻ is



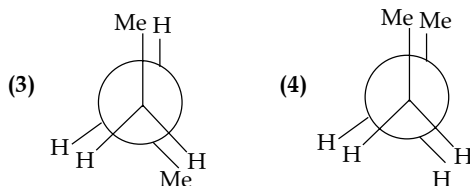
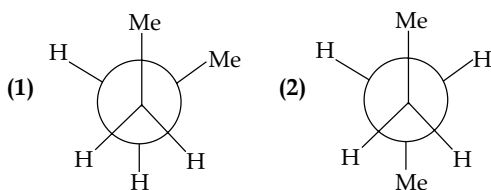
Q. 3. Match List I with List II

LIST I Elements	LIST II Colour imparted to the flame
A. K	I. Brick Red
B. Ca	II. Violet
C. Sr	III. Apple Green
D. Ba	IV. Crimson Red

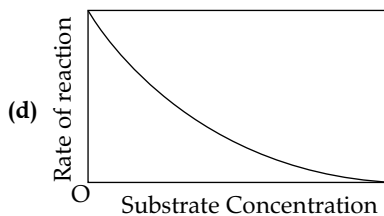
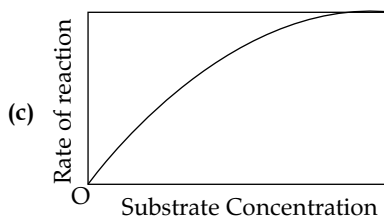
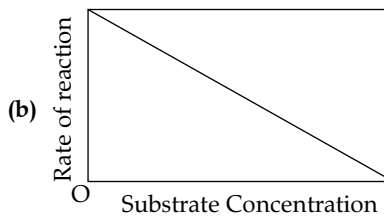
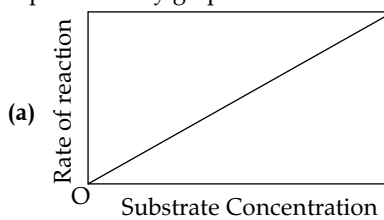
Choose the correct answer from the options given below:

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

Q. 4. Which of the following conformations will be the most stable ?



Q. 5. The variation of the rate of an enzyme catalyzed reaction with substrate concentration is correctly represented by graph



- (1) (b) (2) (a) (3) (d) (4) (c)

Q. 6. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R:

Assertion A : Acetal / Ketal is stable in basic medium.

Reason R : The high leaving tendency of alkoxide ion gives the stability to acetal/ ketal in basic medium.

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

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

- (3) Both A and R are true but R is NOT the correct explanation of A
 (4) Both A and R are true and R is the correct explanation of A
- Q. 7. A cubic solid is made up of two elements X and Y. Atoms of X are present on every alternate corner and one at the center of cube. Y is at $\frac{1}{3}$ rd of the total faces. The empirical formula of the compound is
 (1) $XY_{2.5}$ (2) $X_2Y_{1.5}$ (3) $X_{2.5}Y$ (4) $X_{1.5}Y_2$

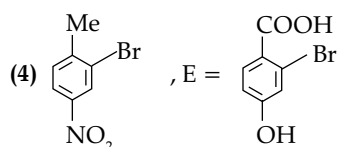
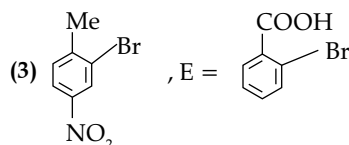
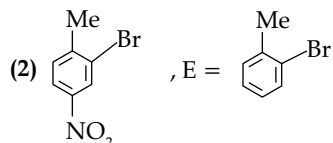
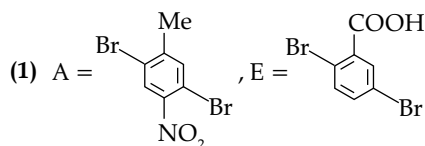
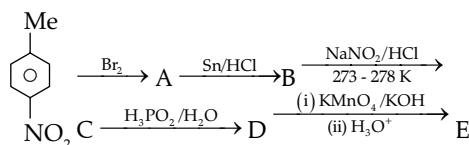
Q. 8. Match the List-I with List-II:

List-I Cations	List-II Group reagents
A. Pb^{2+}, Cu^{2+}	(i) H_2S gas in presence of dilute HCl
B. Al^{3+}, Fe^{3+}	(ii) $(NH_4)_2CO_3$ in presence of NH_4OH
C. Co^{2+}, Ni^{2+}	(iii) NH_4OH in presence of NH_4Cl
D. Ba^{2+}, Ca^{2+}	(iv) H_2S in presence of NH_4OH

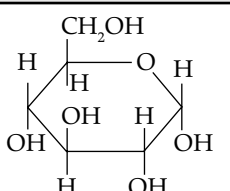
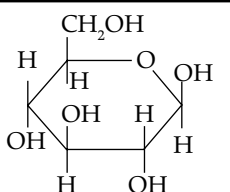
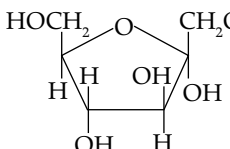
Correct match is –

- (1) $A \rightarrow iii, B \rightarrow i, C \rightarrow iv, D \rightarrow ii$
 (2) $A \rightarrow i, B \rightarrow iii, C \rightarrow ii, D \rightarrow iv$
 (3) $A \rightarrow iv, B \rightarrow ii, C \rightarrow iii, D \rightarrow i$
 (4) $A \rightarrow i, B \rightarrow iii, C \rightarrow iv, D \rightarrow ii$
- Q. 9. Which of the following statements is incorrect for antibiotics?
 (1) An antibiotic must be a product of metabolism.
 (2) An antibiotic should promote the growth or survival of microorganisms.
 (3) An antibiotic is a synthetic substance produced as a structural analogue of naturally occurring antibiotic.
 (4) An antibiotic should be effective in low concentrations.
- Q. 10. The correct order in aqueous medium of basic strength in case of methyl substituted amines is :
 (1) $Me_3N > Me_2NH > MeNH_2 > NH_3$
 (2) $Me_2NH > MeNH_2 > Me_3N > NH_3$
 (3) $Me_2NH > Me_3N > MeNH_2 > NH_3$
 (4) $NH_3 > Me_3N > MeNH_2 > Me_2NH$
- Q. 11. '25 volume' hydrogen peroxide means
 (1) 1 L marketed solution contains 25 g of H_2O_2 .
 (2) 1 L marketed solution contains 75 g of H_2O_2 .
 (3) 1 L marketed solution contains 250 g of H_2O_2 .
 (4) 100 mL marketed solution contains 25 g of H_2O_2 .
- Q. 12. The radius of the 2nd orbit of Li^{2+} is x . The expected radius of the 3rd orbit of Be^{3+} is
 (1) $\frac{27}{16}x$ (2) $\frac{4}{9}x$ (3) $\frac{9}{4}x$ (4) $\frac{16}{27}x$
- Q. 13. Reaction of thionyl chloride with white phosphorus forms a compound [A], which on hydrolysis gives [B], a dibasic acid. [A] and [B] are respectively
 (1) P_4O_6 and H_3PO_3 (2) PCl_5 and H_3PO_4
 (3) $POCl_3$ and H_3PO_4 (4) PCl_3 and H_3PO_3

- Q. 14. Inert gases have positive electron gain enthalpy. Its correct order is
 (1) $He < Kr < Xe < Ne$
 (2) $He < Xe < Kr < Ne$
 (3) $He < Ne < Kr < Xe$
 (4) $Xe < Kr < Ne < He$
- Q. 15. Identify the product formed (and E)



Q. 16. Match items of Row I with those of Row II.

Row I	Row II
	(i) $\alpha - D - (-)$ -Fructofuranose,
	(ii) $\beta - D - (-)$ -Fructofuranose
	(iii) $\alpha - D - (-)$ -Glucopyranose,

Answer Key

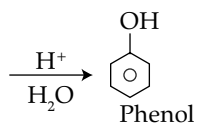
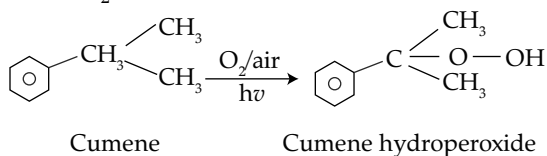
Q. No.	Answer	Topic Name	Chapter Name
1	(3)	Formation of a reaction intermediate	Alcohol, Phenol and Ether
2	(3)	Nucleophilic aromatic substitution	Alkyl and Aryl halides
3	(2)	Flame test	s-block elements
4	(2)	Stable Conformational isomers	General organic chemistry
5	(4)	Rate of reaction	Chemical kinetics
6	(1)	Stability of hemiacetal and acetal	Aldehyde and ketone
7	(Bonus)	Empirical formula	Some basic concept of chemistry
8	(4)	Identification of basic radical	Qualitative analysis
9	(2)	Antibiotic drug	Chemistry in everyday life
10	(2)	Basic strength	Amines
11	(1)	Volume strength of hydrogen peroxide	Hydrogen
12	(1)	Bohr radius calculation	Structure of atom
13	(4)	Chemical properties of P block element	p-block
14	(2)	Electron gain enthalpy order	Periodic classification of elements
15	(3)	Mixed reaction of organic compounds	Amines
16	(4)	Haworth projection	Biomolecules
17	(4)	Extraction of metals	Metallurgy
18	(2)	Smog formation	Environmental chemistry
19	(3)	Preparation of acid	Carboxylic acid
20	(4)	Solvay ammonia process	s-block
21	[60]	Order of reaction	Chemical kinetics
22	[2]	Spin magnetic moment	Structure of atom
23	[42]	Percentage composition	Some basic concept of chemistry
24	[41500]	Osmotic pressure	Liquid solution
25	[12]	Volumetric analysis	Ionic equilibrium
26	[360]	Calculation of energy change	Thermodynamics
27	[4]	Paramagnetic substances	Coordination chemistry
28	[10]	EMF of the cell	Electro chemistry
29	[6]	Number of lone pairs	Chemical bonding
30	[9079]	Buffer solution	Ionic equilibrium

Solutions

Section A

1. Option (3) is correct.

During the formation of phenol from cumene, Cumene hydroperoxide formed as an intermediate. The formation of cumene hydroperoxide from cumene takes place via free radical mechanism in which O_2 acts as an initiator.



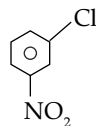
2. Option (3) is correct.

Benzene or benzene derivative easily undergo electrophilic, aromatic substitution. The rate of nucleophilic aromatic substitution of benzene and its derivative depends upon presence of e-withdrawing group.

Rate of Nucleophilic aromatic substitution \propto Number of e-withdrawing group. Also the reactivity is more when these EDW groups are present at ortho and para positions.

Among the given molecule, option (3) is showing less reactivity towards nucleophilic aromatic substitution, because e-withdrawing group is attached at meta position

\therefore Thus meta chloro nitrobenzene has lowest reactivity towards nucleophilic aromatic substitution.

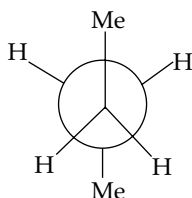


3. Option (2) is correct.

	Element	Colour in flame test	
A	K	II	Violet
B	Ca	I	Brick red
C	Sr	IV	Crimson red
D	Ba	III	Apple green

4. Option (2) is correct.

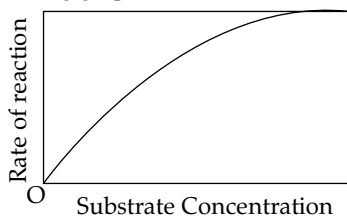
Conformational isomerism is an isomerism in which different structures are formed due to free rotation around carbon — carbon single bond. The structures which are obtained are called conformers of each other and the phenomenon is known as conformational isomerism.



Among the given conformations, the most stable conformer would be one in which bulky groups are present opposite to each other, because such conformer has lowest bond angle and torsional strain and it is called as staggerd-conformer.

5. Option (4) is correct.

The variation of the rate of an enzyme catalyzed reaction with substrate concentration is represented by the following graph



6. Option (1) is correct.

The stability of acetal/ketal in basic medium is more because they do not break down to give back carbonyl group as it do not contain any acidic H — atom, which can react with base. So Assertion is true. The alkoxide (RO⁻) ion are less stable because the electron density on oxygen atom increases by +I effect of alkyl group therefore it is not a good leaving group, hence Reason is false.

7. Bonus

$$\text{Contribution of an atom present at the corners} = \frac{1}{8}$$

$$\text{Contribution of an atom present at face centre} = \frac{1}{3}$$

contribution of an atom present at body centre = 1
Number of X-atom = 4(alternate corner) + 1(Body centre)

$$= 4 \times \frac{1}{8} + 1 \times 1 = \frac{3}{2}$$

$$\text{Number of Y-atom} = \frac{1}{3}(\text{Face centre}) = \frac{1}{3} \times 6 \times \frac{1}{2} = 1$$

$$\text{Empirical formula} = X_{\frac{3}{2}}Y_1$$

No correct Option is given by NTA so Bonus marks will be awarded.

8. Option (4) is correct.

	Cation	Group No	Group Reagent
A	Pb ²⁺ , Cu ²⁺	II	(i) H ₂ S gas in presence of deil HCl
B.	Al ³⁺ , Fe ³⁺	III	(ii) NH ₄ OH in present of NH ₄ C1
C.	Co ²⁺ , Ni ²⁺	IV	(iii) H ₂ S in presence of NH ₄ OH
D.	Ba ²⁺ , Ca ²⁺	V	(iv) (NH ₄) ₂ CO ₃ in presence of NH ₄ OH

9. Option (2) is correct.

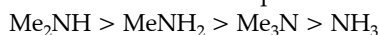
An antibiotic is a class of drug which mainly used to kill or inhibit the growth or survival of micro organism mainly bacteria

Thus statement (2) is an incorrect statement.

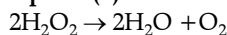
10. Option (2) is correct.

In aqueous medium, basic strength of methylated substituted amines depends upon the +I effect, solvation effect (H bonding) and steric hindereance.

Ammonia would be less basic than its derivatives because +I effect of H is less than that of CH₃ group. Hence the basic strength of methyl substituted amines in aqueous medium is :



11. Option (1) is correct.



Here 25 volume H₂O₂ means at STP,

1L of H₂O₂ on decomposition give 25L O₂

From formula Volume strength = M × 11.35

$$M = \frac{25}{11.35} \text{ M}$$

Strength in $\frac{\text{g}}{\text{L}} \Rightarrow M \times \text{molar mass}$

$$\Rightarrow \frac{25}{11.35} \frac{\text{mol}}{\text{L}} \times 34 \frac{\text{g}}{\text{mol}} \Rightarrow 74.889 \approx 75 \text{ g.}$$

12. Option (1) is correct.

$$\text{Formula used } r_n = 0.529 \text{g} \times \frac{n^2}{Z} \text{A}^\circ$$

For Li²⁺ n = 2 Z = 3

$$r_{\text{Li}^{2+}} = 0.529 \times \frac{2^2}{3} \text{A}^\circ = x \quad \dots \text{(i)}$$

for Be³⁺ n = 3, Z = 4 ... (ii)

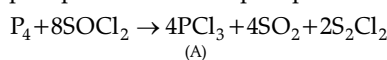
$$r_{\text{Be}^{3+}} = 0.529 \times \frac{(3)^2}{4}$$

from (i) & (ii)

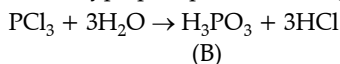
$$\frac{r_{\text{Li}^{2+}}}{r_{\text{Be}^{3+}}} = \frac{0.529 \times \frac{4}{3}}{0.529 \times \frac{9}{4}} \Rightarrow \frac{n}{r_{\text{Be}^{3+}}} = \frac{16}{27} \Rightarrow r_{\text{Be}^{3+}} = \frac{27}{16} x$$

13. Option (4) is correct.

The reaction of thionyl chloride with white phosphorous forms a phosphorous trichloride (PCl₃)



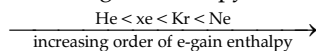
Phosphorous trichloride on hydrolysis gives an acid called hypo phosphorous acid (H_3PO_3)



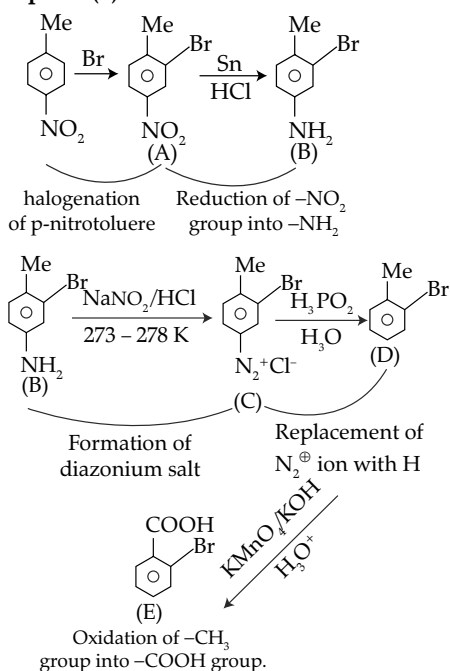
14. Option (2) is correct.

Inert gases have positive electron gain enthalpy due to its stable fully filled configuration

Also as we move down the group, the sizes of atom increases and hence the magnitude of their positive electron enthalpies decreases from Ne to Xe. Due to small size of He, it has highest tendency to accept an additional electron and thus it has lowest positive electron gain enthalpy. Therefore the correct order is



15. Option (3) is correct.



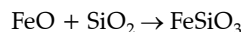
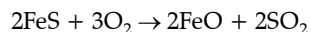
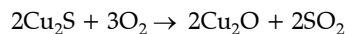
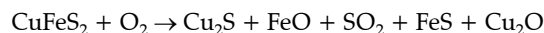
16. Option (4) is correct.

A.		(iii)	α -D-(-) Glucopyranose
B.		(iv)	β -D-(-) Glucopyranose
C.		(i)	α -D-(-) Fructofuranose

D.		(ii)	β -D-(-) Fructofuranose
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17. Option (4) is correct.

The extraction of copper mainly takes place from copper pyrite $CuFeS_2$ by Partial Roasting –

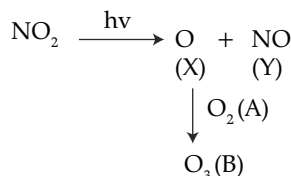


Impurity flux (slag)

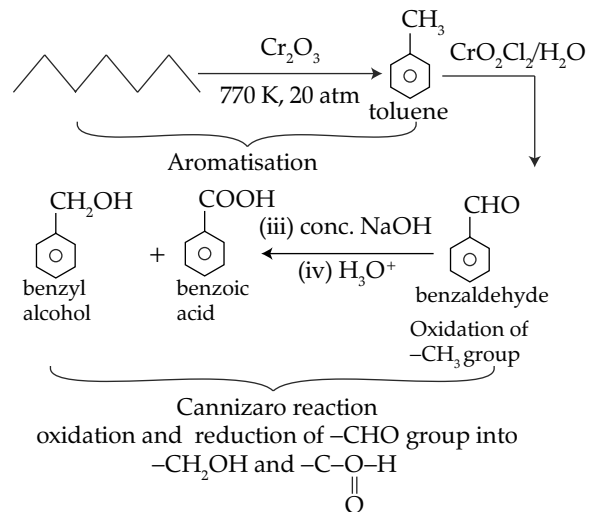
The formation of $CaSiO_3$ does not take place during the extraction of copper.

18. Option (2) is correct.

The reaction of NO_2 in presence of sunlight gives the following –



19. Option (3) is correct.

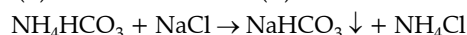
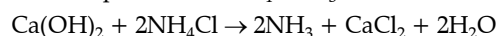


20. Option (4) is correct.

The compound A is $Ca(OH)_2$

The compound B is NH_3

The compound C is NH_4HCO_3



(C)

Section B

21. The correct answer is [60].

Formula used For first order reaction,

$$K = \frac{2.303}{t} \log \frac{90}{90-x}$$

$$\text{Also } K = \frac{0.693}{t \frac{1}{2}} \quad \therefore \text{ Given } t \frac{1}{2} = 30 \text{ min}$$

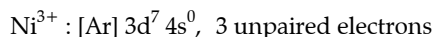
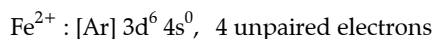
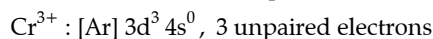
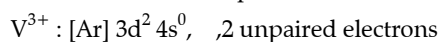
$$K = \frac{0.693}{30}$$

$$a_0 = 100\% \quad a_0 - x = 25\%$$

$$\frac{0.693}{30} = \frac{2.303}{t} \log \frac{100}{25}$$

$$t = \frac{2.303 \times 30}{0.693} \log 4, \quad t = 60 \text{ min}$$

22. The correct answer is [2].

Formula used $\mu = \sqrt{n(n+2)} \text{BM}$ where n = number of unpaired electrons

The species having same value of spin only magnetic moment will be those which have same number of unpaired electrons. Thus two species will have same value of μ i.e., Cr^{3+} and Ni^{3+} .

23. The correct answer is [42].

Formula used:

% of sulphur :

$$= \frac{\text{weight of BaSO}_4}{\text{weight of organic compound}} \times 100$$

233g of BaSO_4 contains 32g of sulphur \therefore 1.4439g of BaSO_4 contains sulphur = $32/233 \times 1.4439$

Given : Weight of organic compound 0.471 gm.

$$\% \text{ of Sulphur} = \frac{1.4439}{0.471} \times \frac{32}{233} \times 100$$

$$= 42\%$$

24. The correct answer is [41500].

Formula used \Rightarrow osmotic pressure, $\pi = CRT$

$$\pi = \frac{n}{v} RT$$

$$\pi = \frac{w}{M^1 \times v} RT$$

$$\pi = C \left(\frac{RT}{M} \right)$$

$$\frac{\pi}{C} = \frac{RT}{M}$$

$$\text{Slope} = \frac{RT}{M} = \frac{0.083 \times 300}{M}$$

$$6 \times 10^{-4} = \frac{0.083 \times 300}{M}$$

$$M = 41500$$

25. The correct answer is [12].

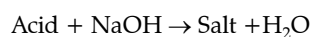
$$\begin{aligned} \text{mole of NaOH} &= \text{Molarity} \times V^{(L)} \\ &= 0.24 \text{ M} \times 25 \times 10^{-3} \text{ L} \\ &= 6 \times 10^{-3} \text{ mol} \end{aligned}$$

For acid

$$\text{density} = 1.21 \text{ kg/L}$$

i.e., 1.21 kg of monobasic acid present in 1 L.

$$\begin{aligned} \text{Molarity} &= \frac{\text{mole}}{V^{(L)}} = \frac{\text{weight}}{\text{mol.wt} \times V^{(L)}} \\ &= \frac{1.21 \times 10^{-3} \text{ gm}}{24.2 \text{ gm/mol} \times 1 \text{ L}} = 50 \text{m} \end{aligned}$$



$$\text{From } M_1 V_1 = M_2 V_2$$

$$50 \text{ M} \times V_1 = 0.24 \text{ M} \times 25 \times 10^{-3} \text{ L}$$

$$V_1 = 1.2 \times 10^{-4} \text{ L}$$

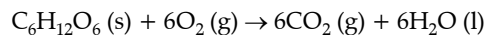
$$= 1.2 \times 18^{-4} \times 10^3 \text{ mL}$$

$$= 1.2 \times 10^{-1} \text{ ML}$$

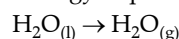
$$= 0.12 \text{ ML}$$

$$V = 12 \times 10^{-2} \text{ mL}$$

26. The correct answer is [360].



The energy required to evaporate water



$$\text{energy utilized} = \frac{1800}{2} = 900 \text{ kJ}$$

Given enthalpy of evaporation of $\text{H}_2\text{O} = 45 \text{ kJ/mol}$

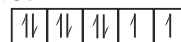
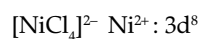
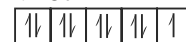
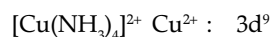
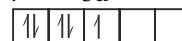
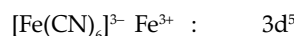
$$\text{moles of H}_2\text{O} = \frac{900 \text{ kJ}}{45 \text{ kJ/mol}}$$

$$\text{moles of H}_2\text{O} = 20 \text{ mol}$$

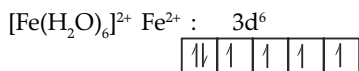
$$W_{\text{H}_2\text{O}} = 20 \text{ mol} \times 18 \frac{\text{gm}}{\text{mol}}$$

$$= 360 \text{ gm}$$

27. The correct answer is [4].

 Cl^- is a weak ligand so e^- 's remain unpaired \therefore it is paramagnetic in nature.Here one unpaired e^- is present \therefore it is paramagnetic in nature.

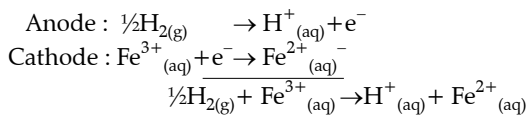
Here one unpaired e^- is present
 \therefore it is paramagnetic in nature.



Here H_2O is a weak ligand so e^- remain unpaired
 \therefore it is paramagnetic in nature.

The other species do not contain unpaired e^- s
 \therefore they are diamagnetic in nature.

28. The correct answer is [10].



$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{n} \log \left[\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} \times \frac{[\text{H}^+]}{(\text{P}_{\text{H}_2})^{\frac{1}{2}}} \right]$$

Given $n = 1$, $E_{\text{cell}}^{\circ} = 0.771 \text{ V}$, $E_{\text{cell}} = 0.712 \text{ V}$
 $[\text{H}^+] = 1 \text{ M}$, $\text{P}_{\text{H}_2} = 1 \text{ atm}$

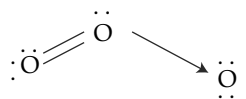
$$0.712 = 0.771 - \frac{0.0591}{1} \log \left[\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} \times \frac{1 \text{ M}}{(1)^{\frac{1}{2}}} \right]$$

$$-0.059 = -0.0591 \log \left[\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} \right]$$

$$\log \left[\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} \right] = 1$$

$$\text{or } \left[\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} \right] = 10$$

29. The correct answer is [6].
 The structure of ozone is



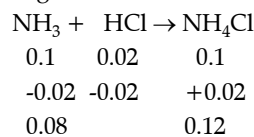
Thus there are 6 lone pairs of electrons on oxygen atoms of ozone.

30. The correct answer is [9079].

Given: No. of moles of $\text{NH}_3 = 0.1$

No. of moles of $\text{NH}_4\text{Cl} = 0.1$

Being acidic HCl reacts with NH_3 to form NH_4Cl



here $\text{pOH} = \text{pK}_b + \log \left[\frac{\text{salt}}{\text{base}} \right]$

$$\text{pOH} = 4.745 + \log \frac{0.12}{0.08}$$

$$\text{pOH} = 4.921$$

$$\text{pH} = 14 - \text{pOH}$$

$$= 14 - 4.921$$

$$\text{pH} = 9.079$$

$$\text{pH} \approx 9079 \times 10^{-3}$$