## JEE (Main) CHEMISTRY SOLVED PAPER

## Section A

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

(2)

(3)

(4)

Q. 2. The compound which will have the lowest rate towards nucleophilic aromatic substitution on treatment with $\mathrm{OH}^{-}$is
(1)

(2)

(3)

(4)

Q. 3. Match List I with List II

| LIST I <br> Elements | LIST II <br> Colour imparted to the <br> 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 ?
(1)

(2)

(3)

(4)

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

(b)

(c)

(d)

(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 $\frac{1}{3} \mathrm{rd}$ of the total faces. The empirical formula of the compound is
(1) $X Y_{2.5}$
(2) $X_{2} Y_{1.5}$
(3) $\mathrm{X}_{2 \cdot 5} \mathrm{Y}$
(4) $\mathrm{X}_{1.5} \mathrm{Y}_{2}$
Q. 8. Match the List-I with List-II:

| List-I <br> Cations |  | List-II <br> Group reagents |  |
| :--- | :--- | :--- | :--- |
| A. | $\mathrm{Pb}^{2+}, \mathrm{Cu}^{2+}$ | (i) | $\mathrm{H}_{2} \mathrm{~S}$ gas in presence <br> of dilute HCl |
| B. | $\mathrm{Al}^{3+}, \mathrm{Fe}^{3+}$ | (ii) | $\left(\mathrm{NH}_{4}\right)_{2} \mathrm{CO}_{3}$ in pres- <br> ence of $\mathrm{NH}_{4} \mathrm{OH}$ |
| C. | $\mathrm{Co}^{2+}, \mathrm{Ni}^{2+}$ | (iii) | $\mathrm{NH}_{4} \mathrm{OH}$ in presence <br> of $\mathrm{NH}_{4} \mathrm{Cl}$ |
| D. | $\mathrm{Ba}^{2+}, \mathrm{Ca}^{2+}$ | (iv) | $\mathrm{H}_{2} \mathrm{~S}$ in presence of <br> $\mathrm{NH}_{4} \mathrm{OH}$ |

Correct match is -
(1) $\mathrm{A} \rightarrow \mathrm{iii}, \mathrm{B} \rightarrow \mathrm{i}, \mathrm{C} \rightarrow \mathrm{iv}, \mathrm{D} \rightarrow \mathrm{ii}$
(2) $\mathrm{A} \rightarrow \mathrm{i}, \mathrm{B} \rightarrow \mathrm{iii}, \mathrm{C} \rightarrow \mathrm{ii}, \mathrm{D} \rightarrow$ iv
(3) $\mathrm{A} \rightarrow \mathrm{iv}, \mathrm{B} \rightarrow \mathrm{ii}, \mathrm{C} \rightarrow \mathrm{iii}, \mathrm{D} \rightarrow \mathrm{i}$
(4) $\mathrm{A} \rightarrow$ 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) $\mathrm{Me}_{3} \mathrm{~N}>\mathrm{Me}_{2} \mathrm{NH}>\mathrm{MeNH}_{2}>\mathrm{NH}_{3}$
(2) $\mathrm{Me}_{2} \mathrm{NH}>\mathrm{MeNH}_{2}>\mathrm{Me}_{3} \mathrm{~N}>\mathrm{NH}_{3}$
(3) $\mathrm{Me}_{2} \mathrm{NH}>\mathrm{Me}_{3} \mathrm{~N}>\mathrm{MeNH}_{2}>\mathrm{NH}_{3}$
(4) $\mathrm{NH}_{3}>\mathrm{Me}_{3} \mathrm{~N}>\mathrm{MeNH}_{2}>\mathrm{Me}_{2} \mathrm{NH}$
Q. 11. ' 25 volume' hydrogen peroxide means
(1) 1 L marketed solution contains 25 g of $\mathrm{H}_{2} \mathrm{O}_{2}$.
(2) 1 L marketed solution contains 75 g of $\mathrm{H}_{2} \mathrm{O}_{2}$.
(3) 1 L marketed solution contains 250 g of $\mathrm{H}_{2} \mathrm{O}_{2}$.
(4) 100 mL marketed solution contains 25 g of $\mathrm{H}_{2} \mathrm{O}_{2}$.
Q. 12. The radius of the $2^{\text {nd }}$ orbit of $\mathrm{Li}^{2+}$ is $x$. The expected radius of the $3^{\text {rd }}$ orbit of $\mathrm{Be}^{3+}$ 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 $[\mathrm{B}]$, a dibasic acid. $[\mathrm{A}]$ and $[\mathrm{B}]$ are respectively
(1) $\mathrm{P}_{4} \mathrm{O}_{6}$ and $\mathrm{H}_{3} \mathrm{PO}_{3}$
(2) $\mathrm{PCl}_{5}$ and $\mathrm{H}_{3} \mathrm{PO}_{4}$
(3) $\mathrm{POCl}_{3}$ and $\mathrm{H}_{3} \mathrm{PO}_{4}$
(4) $\mathrm{PCl}_{3}$ and $\mathrm{H}_{3} \mathrm{PO}_{3}$
Q. 14. Inert gases have positive electron gain enthalpy. Its correct order is
(1) $\mathrm{He}<\mathrm{Kr}<\mathrm{Xe}<\mathrm{Ne}$
(2) $\mathrm{He}<\mathrm{Xe}<\mathrm{Kr}<\mathrm{Ne}$
(3) $\mathrm{He}<\mathrm{Ne}<\mathrm{Kr}<\mathrm{Xe}$
(4) $\mathrm{Xe}<\mathrm{Kr}<\mathrm{Ne}<\mathrm{He}$
Q. 15. Identify the product formed (and $E$ )

(1)

(2)


(3)


(4)

Q. 16. Match items of Row I with those of Row II.
Row I $\quad$ Row II

(1) $\mathrm{A} \rightarrow \mathrm{i}, \mathrm{B} \rightarrow \mathrm{ii}, \mathrm{C} \rightarrow \mathrm{ii}, \mathrm{D} \rightarrow$ iv
(2) $\mathrm{A} \rightarrow \mathrm{iv}, \mathrm{B} \rightarrow$ iii, $\mathrm{C} \rightarrow \mathrm{i}, \mathrm{D} \rightarrow$ ii
(3) $\mathrm{A} \rightarrow \mathrm{iii}, \mathrm{B} \rightarrow \mathrm{iv}, \mathrm{C} \rightarrow \mathrm{ii}, \mathrm{D} \rightarrow \mathrm{i}$
(4) $\mathrm{A} \rightarrow \mathrm{iii}, \mathrm{B} \rightarrow \mathrm{iv}, \mathrm{C} \rightarrow \mathrm{i}, \mathrm{D} \rightarrow \mathrm{ii}$
Q.17. Which one of the following reactions does not occur during extraction of copper ?
(1) $2 \mathrm{Cu}_{2} \mathrm{~S}+3 \mathrm{O}_{2} \rightarrow 2 \mathrm{Cu}_{2} \mathrm{O}+2 \mathrm{SO}_{2}$
(2) $\mathrm{FeO}+\mathrm{SiO}_{2} \rightarrow \mathrm{FeSiO}_{3}$
(3) $2 \mathrm{FeS}+3 \mathrm{O}_{2} \rightarrow 2 \mathrm{FeO}+2 \mathrm{SO}_{2}$
(4) $\mathrm{CaO}+\mathrm{SiO}_{2} \rightarrow \mathrm{CaSiO}_{3}$
Q. 18. Some reactions of $\mathrm{NO}_{2}$ relevant to photochemical smog formation are
$\mathrm{NO}_{2} \xrightarrow{\text { sunlight }} X+Y$


Identify $\mathrm{A}, \mathrm{B} \mathrm{X}$ and Y
(1) $\mathrm{X}=\frac{1}{2} \quad \mathrm{O}_{2}, \mathrm{Y}=\mathrm{NO}_{2}, \mathrm{~A}=\mathrm{O}_{3}, \mathrm{~B}=\mathrm{O}_{2}$
(2) $\mathrm{X}=[\mathrm{O}], \mathrm{Y}=\mathrm{NO}, \mathrm{A}=\mathrm{O}_{2}, \mathrm{~B}=\mathrm{O}_{3}$
(3) $\mathrm{X}=\mathrm{N}_{2} \mathrm{O}, \mathrm{Y}=[\mathrm{O}], \mathrm{A}=\mathrm{O}_{3}, \mathrm{~B}=\mathrm{NO}$
(4) $\mathrm{X}=\mathrm{NO}, \mathrm{Y}=[\mathrm{O}], \mathrm{A}=\mathrm{O}_{2}, \mathrm{~B}=\mathrm{N}_{2} \mathrm{O}_{3}$
Q. 19


The correct sequence of reagents for the preparation of $Q$ and $R$ is :
(1) (i) $\mathrm{CrO}_{2} \mathrm{Cl}_{2}, \mathrm{H}_{3} \mathrm{O}^{+}$; (ii) $\mathrm{Cr}_{2} \mathrm{O}_{3}, 770 \mathrm{~K}, 20 \mathrm{~atm}$; (iii) NaOH ; (iv) $\mathrm{H}_{3} \mathrm{O}^{+}$
(2) (i) $\mathrm{KMnO}_{4}, \mathrm{OH}^{-}$; (ii) $\mathrm{Mo}_{2} \mathrm{O}_{3}, \Delta$; (iii) NaOH ;
(iv) $\mathrm{H}_{3} \mathrm{O}^{+}$
(3) (i) $\mathrm{Cr}_{2} \mathrm{O}_{3}, 770 \mathrm{~K}, 20 \mathrm{~atm}$; (ii) $\mathrm{CrO}_{2} \mathrm{Cl}_{2}, \mathrm{H}_{3} \mathrm{O}^{+}$;
(iii) NaOH ; (iv) $\mathrm{H}_{3} \mathrm{O}^{+}$
(4) (i) $\mathrm{Mo}_{2} \mathrm{O}_{3}, \Delta$; (ii) $\mathrm{CrO}_{2} \mathrm{Cl}_{2}, \mathrm{H}_{3} \mathrm{O}^{+}$; (iii) NaOH ; (iv) $\mathrm{H}_{3} \mathrm{O}^{+}$
Q. 20. Compound $A$ reacts with $\mathrm{NH}_{4} \mathrm{Cl}$ and forms a compound $B$. Compound B reacts with $\mathrm{H}_{2} \mathrm{O}$ and excess of $\mathrm{CO}_{2}$ to form compound C which on passing through or reaction with saturated NaCl solution forms sodium hydrogen carbonate.
Compound $\mathrm{A}, \mathrm{B}$ and C , are respectively.
(1) $\mathrm{CaCl}_{2}, \mathrm{NH}_{3}, \mathrm{NH}_{4} \mathrm{HCO}_{3}$
(2) $\mathrm{Ca}(\mathrm{OH})_{2}, \mathrm{NH}_{4}{ }^{\oplus},\left(\mathrm{NH}_{4}\right)_{2} \mathrm{CO}_{3}$
(3) $\mathrm{CaCl}_{2}, \mathrm{NH}_{4}{ }^{\oplus},\left(\mathrm{NH}_{4}\right)_{2} \mathrm{CO}_{3}$
(4) $\mathrm{Ca}(\mathrm{OH})_{2}, \mathrm{NH}_{3}, \mathrm{NH}_{4} \mathrm{HCO}_{3}$

## Section B

Q. 21. For the first order reaction $A \rightarrow B$, the half life is 30 min . The time taken for $75 \%$ completion of the reaction is $\qquad$ min. (Nearest integer)

Given : $\log 2=0.3010, \log 3=0.4771$,
$\log 5=0.6989$
Q. 22. How many of the following metal ions have similar value of spin only magnetic moment in gaseous state?
(Given: Atomic number : V, 23; Cr, 24; Fe, 26;Ni, 28) $\mathrm{V}^{3+}, \mathrm{Cr}^{3+}, \mathrm{Fe}^{2+}, \mathrm{Ni}^{3+}$
Q. 23. In sulphur estimation, 0.471 g of an organic compound gave 1.4439 g of barium sulphate.
The percentage of sulphur in the compound is (Nearest Integer)
(Given: Atomic mass Ba: 137u, S: 32u, O: 16u)
Q. 24. The osmotic pressure of solutions of PVC in cyclohexanone at 300 K are plotted on the graph. The molar mass of PVC is $\qquad$ $\mathrm{gmol}^{-1}$ (Nearest integer)

(Given : $\mathrm{R}=0.083 \mathrm{~L} \mathrm{~atm} \mathrm{~K}^{-1} \mathrm{~mol}^{-1}$ )
Q. 25. The density of a monobasic strong acid (Molar mass $24.2 \mathrm{~g} / \mathrm{mol}$ ) is $1.21 \mathrm{~kg} / \mathrm{L}$. The volume of its solution required for the complete neutralization of 25 mL of 0.24 MNaOH is $\qquad$ $\times 10^{-2} \mathrm{~mL}$ (Nearest integer)
Q. 26. An athlete is given 100 g of glucose $\left(\mathrm{C}_{6} \mathrm{H}_{12} \mathrm{O}_{6}\right)$ for energy. This is equivalent to 1800 kJ of energy. The $50 \%$ of this energy gained is utilized by the athlete for sports activities at the event. In order to avoid storage of energy, the weight of extra water he would need to perspire is $\qquad$ (Nearest integer) Assume that there is no other way of consuming stored energy.
Given : The enthalpy of evaporation of water is $45 \mathrm{~kJ} \mathrm{~mol}^{-1}$
Molar mass of C,H\&O are 12,1 and $16 \mathrm{~g} \mathrm{~mol}^{-1}$
Q. 27. The number of paramagnetic species from the following is
$\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-},\left[\mathrm{Ni}(\mathrm{CO})_{4}\right],\left[\mathrm{NiCl}_{4}\right]^{2-}$
$\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{4-},\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$
$\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{3-}$ and $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$
Q.28. Consider the cell
$\mathrm{Pt}(\mathrm{s})\left|\mathrm{H}_{2}(\mathrm{~g})(1 \mathrm{~atm})\right| \mathrm{H}^{+}(\mathrm{aq},[\mathrm{H}+]=1)| | \mathrm{Fe}_{3}{ }^{+}(\mathrm{aq})$, $\mathrm{Fe}^{2+}(\mathrm{aq}) \mid \mathrm{Pt}(\mathrm{s})$
Given $\mathrm{E}_{\mathrm{Fe}}^{\circ}{ }^{3+} / \mathrm{Fe}^{2+}=0.771 \mathrm{~V}$ and $\mathrm{E}_{\mathrm{H} / 1 / 2 \mathrm{H} 2}^{\circ}=0 \mathrm{~V}$, $\mathrm{T}=298 \mathrm{~K}$
If the potential of the cell is 0.712 V , the ratio of concentration of $\mathrm{Fe}^{2+}$ to $\mathrm{Fe}^{3+}$ is (Nearest integer)
Q. 29. The total number of lone pairs of electrons on oxygen atoms of ozone is
Q.30. A litre of buffer solution contains 0.1 mole of each of $\mathrm{NH}_{3}$ and $\mathrm{NH}_{4} \mathrm{Cl}$. On the addition of 0.02 mole of HCl by dissolving gaseous HCl , the pH of the solution is found to be ___ $\times 10^{-3}$ (Nearest integer)
[Given : $\mathrm{pK}_{\mathrm{b}}\left(\mathrm{NH}_{3}\right)=4.745, \log 2=0.301$
$\log 3=0.477, \mathrm{~T}=298 \mathrm{~K}]$

## Answer Key

| Q. No. | Answer | Topic Name | Chapter Name |
| :---: | :---: | :--- | :--- |
| $\mathbf{1}$ | $\mathbf{( 3 )}$ | Formation of a reaction intermediate | Alcohol, Phenol and Ether |
| $\mathbf{2}$ | $\mathbf{( 3 )}$ | Nucelophillic aromatic substitution | Alkyl and Aryl halides |
| $\mathbf{3}$ | $\mathbf{( 2 )}$ | Flame test | s-block elements |
| $\mathbf{4}$ | $\mathbf{( 2 )}$ | Stable Conformational isomers | General organic chemistry |
| $\mathbf{5}$ | $\mathbf{( 4 )}$ | Rate of reaxtion | Chemical kinetics |
| $\mathbf{6}$ | $\mathbf{( 1 )}$ | Stability of hemi acetal and acetal | Aldehyde and ketone |
| 7 | $\mathbf{( B o n u s )}$ | Empirical formula | Some basic concept of chemistry |
| $\mathbf{8}$ | $\mathbf{( 4 )}$ | Identification of basic radical | Qualitative analysis |
| $\mathbf{9}$ | $\mathbf{( 2 )}$ | Antibiotic drug | Chemistry in everyday life |
| $\mathbf{1 0}$ | $\mathbf{( 2 )}$ | Basic strength | Amines |
| $\mathbf{1 1}$ | $\mathbf{( 1 )}$ | Volume strength of hydrogen per oxide | Hydrogen |
| $\mathbf{1 2}$ | $\mathbf{( 1 )}$ | Bohr radius calculation | Structure of atom |
| $\mathbf{1 3}$ | $\mathbf{( 4 )}$ | Chemical properties of P block element | p-block |
| $\mathbf{1 4}$ | $\mathbf{( 2 )}$ | Electron gain enthalpy order | Periodic classification of elements |
| $\mathbf{1 5}$ | $\mathbf{( 3 )}$ | Mixed reaction of organic compounds | Amines |
| $\mathbf{1 6}$ | $\mathbf{( 4 )}$ | Haworth projection | Biomolecules |
| $\mathbf{1 7}$ | $\mathbf{( 4 )}$ | Extraction of metals | Metallurgy |
| $\mathbf{1 8}$ | $\mathbf{( 2 )}$ | Smog formation | Environmental chemistry |
| $\mathbf{1 9}$ | $\mathbf{( 3 )}$ | Preparation of acid | Carboxylicacid |
| 20 | $\mathbf{( 4 )}$ | 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 | $[\mathbf{1 2 ]}$ | Volumetric analysis | Ionic equilibrium |
| 26 | $[360]$ | Calculation of energy change | Thermodynamics |
| 27 | $[4]$ | Paramagnetic substances | Coordination chemistry |
| 28 | $[\mathbf{1 0 ]}$ | EMF of the cell | Electro chemistry |
| $\mathbf{2 9}$ | $[6]$ | Number of lone pairs | Chemical bonding |
| $\mathbf{3 0}$ | $[9079]$ | 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 $\mathrm{O}_{2}$ acts as an initiator.


2. Option (3) is correct.

Benzene or benzene derivative easily undergo electrophilic, aromatic substitution. The rate of nucleophillic aromatic substitution of benzene and its derivative depends upon presence of e-withdrawing group.
Rate of Nuelcophillic aromatic substitution $\alpha$ Number of $e$ - withdrawing group. Also the reactivity is more when these EDW groups are present at ortho and para positions.
Amony 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 nucleophillic 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 ( $\mathrm{RO}^{-}$) 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

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

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

Number of Y-atom $=\frac{1}{3}($ Face centre $)=\frac{1}{3} \times 6 \times \frac{1}{2}=1$
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 | $\mathrm{Pb}^{2+}, \mathrm{Cu}^{2+}$ | II | (i) | $\mathrm{H}_{2} \mathrm{~S}$ gas in presence <br> of deil $\mathrm{HC1}$ |
| B. | $\mathrm{Al}^{3+}, \mathrm{Fe}^{3+}$ | III | (ii) | $\mathrm{NH}_{4} \mathrm{OH}$ in present <br> of $\mathrm{NH}_{4} \mathrm{C1}$ |
| C. | $\mathrm{Co}^{2+}, \mathrm{Ni}^{2+}$ | IV | (iii) | $\mathrm{H}_{2} \mathrm{~S}$ in presence of <br> $\mathrm{NH}_{4} \mathrm{OH}$ |
| D. | $\mathrm{Ba}^{2+}, \mathrm{Ca}^{2+}$ | V | (iv) | $\left(\mathrm{NH}_{4}\right)_{2} \mathrm{CO}_{3}$ in <br> presence of $\mathrm{NH}_{4} \mathrm{OH}$ |

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 $\operatorname{effect}(\mathrm{H}$ bonding) and steric hindereance.
Ammonia would be less basic than its derivatives because +I effect of H is less than that of $\mathrm{CH}_{3}$ group. Hence the basic strength the basic strength of methyl substituted amines in aqueous medium is :
$\mathrm{Me}_{2} \mathrm{NH}>\mathrm{MeNH}_{2}>\mathrm{Me}_{3} \mathrm{~N}>\mathrm{NH}_{3}$
11. Option (1) is correct.
$2 \mathrm{H}_{2} \mathrm{O}_{2} \rightarrow 2 \mathrm{H}_{2} \mathrm{O}+\mathrm{O}_{2}$
Here 25 volume $\mathrm{H}_{2} \mathrm{O}_{2}$ means at STP,
1 L of $\mathrm{H}_{2} \mathrm{O}_{2}$ on decomposition give $25 \mathrm{~L} \mathrm{O}_{2}$
From formula Volume strength $=\mathrm{M} \times 11.35$
$\mathrm{M}=\frac{25}{11.35} \mathrm{M}$
Strength in $\frac{\mathrm{g}}{\mathrm{L}} \Rightarrow \mathrm{M} \times$ molar mass
$\Rightarrow \frac{25}{11.35} \frac{\mathrm{~mol}}{\mathrm{~L}} \times 34 \frac{\mathrm{~g}}{\mathrm{~mol}} \Rightarrow 74.889 \approx 75 \mathrm{~g}$.

## 12. Option (1) is correct.

Formula used $r_{n}=0.52 \mathrm{~g} \times \frac{\mathrm{n}^{2}}{\mathrm{z}} \mathrm{A}^{\circ}$
For $\mathrm{Li}^{2+} n=2 \mathrm{Z}=3$
$\mathrm{r}_{\mathrm{L}: 2+}=0.529 \times \frac{2^{2}}{3} \mathrm{~A}^{\circ}=x$
for $\mathrm{Be}^{3+} n=3, \mathrm{Z}=4$
$\mathrm{r}_{\text {Be }^{3+}}=0.529 \times \frac{(3)^{2}}{4}$
from (i) \& (ii)
$\frac{\mathrm{r}_{\mathrm{Li} 2+}}{\mathrm{r}_{\mathrm{Be}^{3+}}}=\frac{0.529 \times \frac{4}{3}}{0.529 \times \frac{9}{4}} \Rightarrow \frac{\mathrm{n}}{\mathrm{r}_{\mathrm{Be}^{3+}}}=\frac{16}{27} \Rightarrow \mathrm{r}_{\mathrm{Be}^{3+}}=\frac{27}{16} x$
13. Option (4) is correct.

The reaction of thionyl chloride with white phosphorous forms a phosphorous trichloride $\left(\mathrm{PCl}_{3}\right)$ $\mathrm{P}_{4}+8 \mathrm{SOCl}_{2} \rightarrow 4 \mathrm{PCl}_{3}+4 \mathrm{SO}_{2}+2 \mathrm{~S}_{2} \mathrm{Cl}_{2}$
(A)

Phosphorous trichloride on hydrolysis gives an acid called hypo phosphorous acid $\left(\mathrm{H}_{3} \mathrm{PO}_{3}\right)$
$\mathrm{PCl}_{3}+3 \mathrm{H}_{2} \mathrm{O} \rightarrow \mathrm{H}_{3} \mathrm{PO}_{3}+3 \mathrm{HCl}$
(B)
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
$\xrightarrow[\text { increasing order of e-gain enthalpy }]{\mathrm{He}<\mathrm{xe}<\mathrm{Kr}<\mathrm{Ne}}$
15. Option (3) is correct.



16. Option (4) is correct.

| A. |  | (iii) | $\begin{aligned} & \alpha-\mathrm{D}-(-) \text { Glu- } \\ & \text { copyranose } \end{aligned}$ |
| :---: | :---: | :---: | :---: |
| B. |  | (iv) | $\beta$-D-(-) Glucopyranose |
| C. |  | (i) | $\begin{gathered} \alpha-\mathrm{D}-(-) \\ \text { Fructofura- } \\ \text { nose } \end{gathered}$ |


17. Option (4) is correct.

The extraction of copper mainly takes place from copper pyrite $\mathrm{CuFeS}_{2}$ by Partial Roasting -
$\mathrm{CuFeS}_{2}+\mathrm{O}_{2} \rightarrow \mathrm{Cu}_{2} \mathrm{~S}+\mathrm{FeO}+\mathrm{SO}_{2}+\mathrm{FeS}+\mathrm{Cu}_{2} \mathrm{O}$
$2 \mathrm{Cu}_{2} \mathrm{~S}+3 \mathrm{O}_{2} \rightarrow 2 \mathrm{Cu}_{2} \mathrm{O}+2 \mathrm{SO}_{2}$
$2 \mathrm{FeS}+3 \mathrm{O}_{2} \rightarrow 2 \mathrm{FeO}+2 \mathrm{SO}_{2}$
$\mathrm{FeO}+\mathrm{SiO}_{2} \rightarrow \mathrm{FeSiO}_{3}$
Impurity flux (slag)
The formation of $\mathrm{CaSiO}_{3}$ does not takes place during the extraction of copper.
18. Option (2) is correct.

The reaction of $\mathrm{NO}_{2}$ in presence of sunlight gives the following -

19. Option (3) is correct.

20. Option (4) is correct.

The compound A is $\mathrm{Ca}(\mathrm{OH})_{2}$
The compound B is $\mathrm{NH}_{3}$
The compound C is $\mathrm{NH}_{4} \mathrm{HCO}_{3}$
$\mathrm{Ca}(\mathrm{OH})_{2}+2 \mathrm{NH}_{4} \mathrm{Cl} \rightarrow 2 \mathrm{NH}_{3}+\mathrm{CaCl}_{2}+2 \mathrm{H}_{2} \mathrm{O}$
(A)
(B)
$\mathrm{NH}_{3}+\mathrm{H}_{2} \mathrm{O}+\mathrm{CO}_{2} \rightarrow \mathrm{NH}_{4} \mathrm{HCO}_{3}$
(B)
(C)
$\mathrm{NH}_{4} \mathrm{HCO}_{3}+\mathrm{NaCl} \rightarrow \mathrm{NaHCO}_{3} \downarrow+\mathrm{NH}_{4} \mathrm{Cl}$
(C)

## Section B

21. The correct answer is [60].

Formula used For first order reaction,
$K=\frac{2.303}{\mathrm{t}} \log \frac{90}{90-x}$

$$
\text { Also } \begin{aligned}
\mathrm{K}=\frac{0.693}{\mathrm{t} \frac{1}{2}} & \because \text { Given } \mathrm{t} \frac{1}{2}=30 \mathrm{~min} \\
\mathrm{~K} & =\frac{0.693}{30} \\
a_{0} & =100 \% \\
\frac{0.693}{30} & =\frac{2.303}{\mathrm{t}} \log \frac{100}{25} \\
\mathrm{t} & =\frac{2.303 \times 30}{0.693} \log 4, t=60 \mathrm{~min}
\end{aligned}
$$

22. The correct answer is [2].

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

$$
\mathrm{V}^{3+}:[\mathrm{Ar}] 3 \mathrm{~d}^{2} 4 \mathrm{~s}^{0}, \quad, 2 \text { unpaired electrons }
$$

$\mathrm{Cr}^{3+}:[\mathrm{Ar}] 3 \mathrm{~d}^{3} 4 \mathrm{~s}^{0}, 3$ unpaired electrons
$\mathrm{Fe}^{2+}:[\mathrm{Ar}] 3 \mathrm{~d}^{6} 4 \mathrm{~s}^{0}, 4$ unpaired electrons
$\mathrm{Ni}^{3+}$ : [Ar] $3 \mathrm{~d}^{7} 4 \mathrm{~s}^{0}$, 3 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 $\mu$ i.e., $\mathrm{Cr}^{3+}$ and $\mathrm{Ni}^{3+}$.
23. The correct answer is [42].

Formula used:
\% of sulphur :

$$
=\frac{\text { weight of } \mathrm{BaSO}_{4}}{\text { weight of organic compound }} \times 100
$$

233 g of $\mathrm{BaSO}_{4}$ contains 32 g of sulphur
$\therefore 1.4439 \mathrm{~g}$ of $\mathrm{BaSO}_{4}$ contains sulphur $=32 / 233^{*} 1.4439$
Given : Weight of organic compound 0.471 gm.
$\%$ of Sulphur $=\frac{1.443 \mathrm{~g}}{0.471} \times \frac{32}{233} \times 100$

$$
=42 \%
$$

24. The correct answer is [41500].

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

$$
\begin{aligned}
& \pi=\frac{\mathrm{n}}{\mathrm{~V}} \mathrm{RT} \\
& \pi=\frac{w}{\mathrm{M}^{1} \times \mathrm{v}} \mathrm{RT} \\
& \pi=\mathrm{C}\left(\frac{\mathrm{RT}}{\mathrm{M}}\right) \\
& \frac{\pi}{\mathrm{C}}=\frac{\mathrm{RT}}{\mathrm{M}}
\end{aligned}
$$

$$
\begin{aligned}
\text { Slope } & =\frac{R T}{M}=\frac{0.083 \times 300}{M} \\
6 \times 10^{-4} & =\frac{0.083 \times 300}{M} \\
M & =41500
\end{aligned}
$$

25. The correct answer is [12].

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

For acid

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

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

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

$$
\begin{aligned}
\text { Acid }+\mathrm{NaOH} & \rightarrow \text { Salt }+\mathrm{H}_{2} \mathrm{O} \\
\text { From } \mathrm{M}_{1} \mathrm{~V}_{1} & =\mathrm{M}_{2} \mathrm{~V}_{2} \\
50 \mathrm{M} \times \mathrm{V}_{1} & =0.24 \mathrm{M} \times 25 \times 10^{-3} \mathrm{~L} \\
\mathrm{~V}_{1} & =1.2 \times 10^{-4} \mathrm{~L} \\
& =1.2 \times 18^{-4} \times 10^{3} \mathrm{~mL} \\
& =1.2 \times 10^{-1} \mathrm{ML} \\
& =0.12 \mathrm{ML} \\
\mathrm{~V} & =12 \times 10^{-2} \mathrm{~mL}
\end{aligned}
$$

26. The correct answer is [360].
$\mathrm{C}_{6} \mathrm{H}_{12} \mathrm{O}_{6}(\mathrm{~s})+6 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow 6 \mathrm{CO}_{2}(\mathrm{~g})+6 \mathrm{H}_{2} \mathrm{O}$ (l) The energy required to evaporate water

$$
\mathrm{H}_{2} \mathrm{O}_{(\mathrm{l})} \rightarrow \mathrm{H}_{2} \mathrm{O}_{(\mathrm{g})}
$$

energy utilized $=\frac{1800}{2}=900 \mathrm{~kJ}$
Given enthalpy of evaporation of $\mathrm{H}_{2} \mathrm{O}=45 \mathrm{~kJ} / \mathrm{mol}$
moles of $\mathrm{H}_{2} \mathrm{O}=\frac{900 \mathrm{~kJ}}{45 \mathrm{~kJ} / \mathrm{mol}}$
moles of $\mathrm{H}_{2} \mathrm{O}=20 \mathrm{~mol}$
$\mathrm{W}_{\mathrm{H}_{2} \mathrm{O}}=20 \mathrm{~mol} \times 18 \frac{\mathrm{gm}}{\mathrm{mol}}$
$=360 \mathrm{gm}$

## 27. The correct answer is [4].

$\left[\mathrm{NiCl}_{4}\right]^{2-} \mathrm{Ni}^{2+}: 3 \mathrm{~d}^{8}$

$\mathrm{Cl}^{-}$is a weak ligand so $\mathrm{e}^{-} \mathrm{s}$ remain unpaired
$\therefore$ it is paramagnetic in nature.

$$
\begin{aligned}
& {\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+} \mathrm{Cu}^{2+}: 3 \mathrm{~d}^{9}} \\
& \qquad \begin{array}{|l|l|l|l|l|}
\hline 1 / & 16 & 1 / & 11 & 1 \\
\hline
\end{array}
\end{aligned}
$$

Here one unpaired $\mathrm{e}^{-}$is a present $\therefore$ it is paramagnetic in nature.

| $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{3-} \mathrm{Fe}^{3+}$ | $:$ |
| ---: | :--- |
|  |  $3 \mathrm{~d}^{5}$ |

Here one unpaired $\mathrm{e}^{-}$is a present
$\therefore$ it is paramagnetic in nature.
$\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right)^{2+} \mathrm{Fe}^{2+}$ : $3 \mathrm{~d}^{6}$

| 1 | 1 | 1 | 1 | 1 |
| :--- | :--- | :--- | :--- | :--- |

Here $\mathrm{H}_{2} \mathrm{O}$ is a weak ligand so $\mathrm{e}^{-}$remain unpaired $\therefore$ it is paramagnetic in nature.
The other species do not contain unpaired $\mathrm{e}^{-} \mathrm{s}$
$\therefore$ they are diamagnetic in nature.
28. The correct answer is [10].

Anode: $1 / 2 \mathrm{H}_{2(\mathrm{~g})} \rightarrow \mathrm{H}_{(\mathrm{aq})}^{+}+\mathrm{e}^{-}$
Cathode : $\mathrm{Fe}^{3+}{ }_{(\mathrm{aq})}{ }^{+} \mathrm{e}^{-} \rightarrow \mathrm{Fe}^{2+}{ }_{(\mathrm{aq})}{ }^{-}$

$$
1 / 2 \mathrm{H}_{2(\mathrm{~g})}+\mathrm{Fe}^{3+}{ }_{(\mathrm{aq})} \rightarrow \mathrm{H}_{(\mathrm{aq})}^{+}+\mathrm{Fe}^{2+}{ }_{(\mathrm{aq})}
$$

$\mathrm{E}_{\text {cell }}=\mathrm{E}_{\text {cell }}^{\mathrm{o}}-\frac{0.0591}{\mathrm{n}} \log \left[\frac{\mathrm{Fe}^{2+}}{\mathrm{Fe}^{3+}}\right] \times \frac{\left[\mathrm{H}^{+}\right]}{\left(\mathrm{P}_{\mathrm{H} 2}\right)^{\frac{1}{2}}}$
Given $\mathrm{n}=1, \mathrm{E}_{\text {cell }}^{\mathrm{o}}=0.771 \mathrm{VE}_{\text {cell }}=0.712 \mathrm{~V}$ $\left[\mathrm{H}^{+}\right]=1 \mathrm{M} \mathrm{P}_{\mathrm{H} 2}=1 \mathrm{~atm}$
$0.712=0.771-\frac{0.0591}{1} \log \left[\frac{\mathrm{Fe}^{2+}}{\mathrm{Fe}^{3+}}\right] \times \frac{1 \mathrm{M}}{(1)^{\frac{1}{2}}}$
$-0.059=-0.0591 \log \left[\frac{\mathrm{Fe}^{2+}}{\mathrm{Fe}^{3+}}\right]$
$\log \left[\frac{\mathrm{Fe}^{2+}}{\mathrm{Fe}^{3+}}\right]=1$
or $\left[\frac{\mathrm{Fe}^{2+}}{\mathrm{Fe}^{3+}}\right]=10$
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 $\mathrm{NH}_{3}=0.1$
No. of moles of $\mathrm{NH}_{4} \mathrm{Cl}=0.1$
Being acidic HCl reacts with $\mathrm{NH}_{3}$ to form $\mathrm{NH}_{4} \mathrm{Cl}$

$$
\begin{array}{ccc}
\mathrm{NH}_{3}+ & \mathrm{HCl} \rightarrow & \mathrm{NH}_{4} \mathrm{Cl} \\
0.1 & 0.02 & 0.1 \\
-0.02 & -0.02 & +0.02 \\
0.08 & & 0.12
\end{array}
$$

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

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

$$
\mathrm{pOH}=4.921
$$

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

$$
=14-4.921
$$

$$
\mathrm{pH}=9.079
$$

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

