Guess Paper: 2014
Class: XII

Time Allowed: 3Hours
Maximum Marks: 70

General Instructions:

1. All questions are compulsory.
2. There are 30 Questions in all.
3. “Section – A” from 1 to 8 carry 1 mark each.
4. “Section – B” from 9 to 18 carry 2 marks each.
5. “Section – C” from 19 to 27 carry 3 marks each.
6. “Section – D” from 28 to 30 carry 5 marks each.
7. Internal choices have been provided in some questions. Use Log Tables, if necessary.

“Section – A”

Q 1. Arrange the following compounds in order of increasing boiling points.

1–Chloropropane, Isopropyl chloride, 1–Chlorobutane

Q 2. For the reaction: \( \text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g}) \)

If \( \frac{\Delta [\text{NH}_3]}{\Delta t} = 4 \times 10^{-8} \text{mol}^{-1}\text{s}^{-1} \), what is the value of \( \frac{\Delta [\text{H}_2]}{\Delta t} \)?

Q 3. ‘Crystalline solids are anisotropic in nature.’ What does this statement mean?

Q 4. What would happen if no salt bridge were used in an electrochemical cell (like Zn–Cu cell)?
Q 5. CuSO₄·5H₂O is blue in colour while CuSO₄ is colourless. Why?

Q 6. Draw the structure of XeO₃ molecule?

Q 7. Write the structural formula and IUPAC name of isobutyl alcohol?

Q 8. Arrange the following in order of decreasing ease of dehydration:

(CH₃)₂COH, CH₃CH₂OH, (CH₃)₂CHOH

“Section - B”

Q 9. The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere.

Q 10. State Raoult’s law for a solution containing volatile liquids. Explain with suitable example the concept of maximum boiling azeotrope.

Q 11. An aqueous solution containing urea was found to have to have boiling point more than the normal boiling point of water (373.13 K). When the same solution was cooled it was found that its freezing point is less than the normal freezing point of water (273.13 K). Explain these observations.

Q 12. Propose mechanism of the reaction taking place when:

(a) (−) – 2 – Bromo – octane reacts with sodium hydroxide to form (+) – octane – 2 – ol.
(b) 2-Bromo pentane is heated with alcoholic KOH to form alkenes.

OR
State reasons for each of the following:
(a) All the P-Cl bonds in PCI₅ molecule are not equivalent.
(b) Sulphur has greater tendency for catenation than oxygen.

Q 13. Assign reasons for the following:
(a) Transition metal fluorides are ionic in nature whereas bromides and chlorides are usually covalent in nature.
(b) Chemistry of all the lanthanoids is quite similar.

Q 14. Explain the following giving one example for each:
(a) Cannizzaro Reaction
(b) Reimer–Teimann Reaction

Q 15. Describe a chemical test in each case to distinguish between the following pairs of compounds:
(a) Aniline and N-ethylaniline.
(b) N-Methyl propan-2-amine and N-Ethyl-N-methylethanamine.

Q 16. What is essentially the difference between α-form of glucose and β-form of glucose Explain?

Q 17. Describe what you understand by primary structure & secondary structure of proteins.

Q 18. How do antiseptics differ from disinfectants? Give one example of each.

“Section – C”

Q 19. Silver crystallizes in face-centred cubic unit cell. Each side of this unit cell has a length of 400 pm. Calculate the radius of the silver atom. (Assume the atoms just touch each other on the diagonal across the face of the unit cell. That is each face atom is touching the four corner atoms.)

Q 20. Nitrogen pentoxide decomposes according to equation
\[ 2N_2O_5 (g) \rightarrow 4NO_2 (g) + O_2 (g) \]

This first order reaction was allowed to proceed at 40 °C and the data below were collected:

<table>
<thead>
<tr>
<th>([N_2O_5]) (M)</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.400</td>
<td>0.00</td>
</tr>
<tr>
<td>0.289</td>
<td>20.0</td>
</tr>
<tr>
<td>0.209</td>
<td>40.0</td>
</tr>
<tr>
<td>0.151</td>
<td>60.0</td>
</tr>
<tr>
<td>0.109</td>
<td>80.0</td>
</tr>
</tbody>
</table>

(a) Calculate the rate constant. Include units with your answer.
(b) What will be the concentration of \(N_2O_5\) after 100 minutes?
(c) Calculate the initial rate of reaction.

Q 21. (a) On the basis of Hardy–Schulze rule explain why the coagulating power of phosphate is higher than chloride.
(b) Do the vital functions of the body such as digestion get affected during fever? Explain your answer.

OR

Give reasons:
(a) Gelatine is generally added to ice-creams.
(b) Effect of prolonged dialysis.
(c) Peptising agent is added to convert precipitate into colloidal solution.

Q 22. Describe the principle behind each of the following processes:
(i) Vapour phase refining of a metal.
(ii) Electrolytic refining of a metal.
(iii) Recovery of silver after silver ore was leached with NaCN.

Q 23. Complete the following chemical equations:

(i) \( \text{CH}_3\text{CH}_2\text{NH}_2 + \text{CHCl}_3 + \text{AICl}_3 + \text{KOH} \rightarrow \)

(ii) \( \text{KMnO}_4 \xrightarrow{\text{Heated}} \)

(iii) \( \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{S} + \text{H}^+ \rightarrow \)

Q 24. Write the name, stereochemistry and magnetic behaviour of the following:

(Atomic numbers: Mn = 25, Co = 27, Ni = 28)

(i) \( \text{K}_4\left[\text{Mn(CN)}_6\right] \)

(ii) \( \text{[Co(NH}_3)_5\text{Cl]}\text{Cl}_2 \)

(iii) \( \text{K}_2\left[\text{Ni(CN)}_4\right] \)

Q 25. Answer the following:

(a) Alcohols are more soluble in water than the hydrocarbons of comparable molecular masses.

(b) \( \text{C} - \text{X} \) bond length in halobenzene is smaller than \( \text{C} - \text{X} \) bond length in \( \text{CH}_3 - \text{X} \).

(c) Of the two bromo derivatives, \( \text{C}_6\text{H}_5\text{CH}(\text{CH}_3)\text{Br} \) and \( \text{C}_6\text{H}_5\text{CH} (\text{C}_6\text{H}_5)\text{Br} \), which one is more reactive in \( \text{S}_\text{N}1 \) substitution reaction and why?

Q 26. (a) Explain why an alkyl-amine is more basic than ammonia.

(b) How would you convert

(i) Aniline to nitro-benzene
(ii) Aniline to iodo-benzene?

Q 27. Describe the following giving one example for each

(a) Tranquilizers
(b) Artificial sweetener
(c) Antihistamines
“Section – D”

Q 28. The experimental data for decomposition of \(N_2O_5\)

\[
2N_2O_5 \rightarrow 4NO_2 + O_2
\]

In gas phase at 318K are given below:

<table>
<thead>
<tr>
<th>t(s)</th>
<th>0</th>
<th>400</th>
<th>800</th>
<th>1200</th>
<th>1600</th>
<th>2000</th>
<th>2400</th>
<th>2800</th>
<th>3200</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10^2[N_2O_5] \text{ mol/l} )</td>
<td>1.63</td>
<td>1.36</td>
<td>1.14</td>
<td>0.93</td>
<td>0.78</td>
<td>0.6</td>
<td>0.53</td>
<td>0.43</td>
<td>0.35</td>
</tr>
</tbody>
</table>

(a) Plot \([N_2O_5]\) against \(t\).
(b) Find the half-life period for the reaction.
(c) Draw a graph between log \([N_2O_5]\) and \(t\).
(d) What is the rate law?
(e) Calculate the rate constant.
(f) Calculate the half-life period from \(k\) and compare it with (b).

OR

(a) In a reaction between A and B, the initial rate of reaction \(r_o\) was measured for different initial concentrations of A and B as given below:

<table>
<thead>
<tr>
<th>A/ mol L(^{-1})</th>
<th>0.20</th>
<th>0.20</th>
<th>0.40</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/ mol L(^{-1})</td>
<td>0.30</td>
<td>0.10</td>
<td>0.05</td>
</tr>
<tr>
<td>(r_o/\text{mol L}^{-1} \text{s}^{-1})</td>
<td>(5.07\times10^{-5})</td>
<td>(5.07\times10^{-5})</td>
<td>(1.43\times10^{-4})</td>
</tr>
</tbody>
</table>

What is the order of the reaction with respect to A and B?
(b) The time required for 10\% completion of a first order reaction at 298 K is equal to that required for its 25\% completion at 308 K. The value of \(A\) is \(4 \times 10^{10} \text{s}^{-1}\). Calculate \(k\) at 318 K and \(E_a\).
Q 29. (a) (i) Ammonia (NH₃) has a higher boiling point than phosphine (PH₃).
   (ii) SO₂ is a gas while SeO₂ is a solid at room temperature.

   (b) Complete the following reaction:
   (i) Cu + H₂SO₄ →
   (ii) SCl₂ + NaF →

   (c) Why is Ka₂ << Ka₁ for H₂SO₄ in water?

(a) The HNH angle value is higher than HPH, HAsH, and HSbH angles. Why?
(b) Differentiate between the basic oxide, acidic oxide and amphoteric oxide?
(c) How is ozone produced in the atmosphere? What are the possible advantages of the ozone layer present in the upper atmosphere? Why is ozone not present in the lower layer of atmosphere?

Q 30. (a) An alkyl halide ‘X’ on reaction with aq. NaOH gives a product capable of being resolved into optical isomer. Write the structure and IUPAC name of ‘X’?

   b) What is the expected product from the reactions of
   (i) LiAlH₄
   (ii) H₂/Pt

   (c) Convert:
   (i) Ethanal into 2 – hydroxyl – 3 – butenoic acid.
   (ii) Methanal into n−butane
OR

(a) Give the products that are formed by heating each of the following compounds of ether with HI:

(i) \[ \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{OCH}_2\text{CH}_3 \]

(ii) \[ \text{CH}_3\text{CH}_2\text{CH}_2\text{O} - \text{C} - \text{CH}_2\text{CH}_3 \]

(iii) ![Structure of a compound]

(b) Organic compound A (C\(_3\)H\(_8\)O) gives a sweet smelling compound on reaction with CH\(_3\)COOH in the presence of an acid. On dehydrogenation, A gives another organic compound B (C\(_3\)H\(_6\)O), B gives a crystalline product with sodium hydrogen sulphite and oxidation of B with K\(_2\)Cr\(_2\)O\(_7\)/H\(_2\)SO\(_4\) gives propionic acid. Write the structure of compound A and B and explain the reactions involved.

(c) Give reasons:

(i) Lower ethers are soluble in water, alkanes are not.

(ii) CH\(_2\) = CH \(\Theta\) CH\(_2\)CH\(_3\) is less soluble in water than CH\(_3\)CH\(_2\)OCH\(_2\)CH\(_3\).
“Section – A”

**Answer 1:** The order of increasing boiling point is:
Isopropyl Chloride < 1–Chloropropane < 1–Chlorobutane

**Answer 2:** The rate of the reaction $\frac{1}{3} \frac{\Delta [H_2]}{\Delta t} = \frac{1}{2} \frac{\Delta [NH_3]}{\Delta t}$

\[
\frac{1}{3} \frac{\Delta [H_2]}{\Delta t} = \frac{1}{2} \frac{\Delta [NH_3]}{\Delta t} = \frac{1}{2} \times 4 \times 10^{-8} \text{ mol} \cdot \text{s}^{-1} \\
\frac{\Delta [H_2]}{\Delta t} = 3 \times 10^{-4} \text{ mol} \cdot \text{m}^{-3} \cdot \text{s}^{-1} \\
\frac{\Delta [H_2]}{\Delta t} = 10^{-8} \text{ mol} \cdot \text{l}^{-1} \cdot \text{s}^{-1}
\]

The value of $-\frac{\Delta [H_2]}{\Delta t}$ is $6 \times 10^{-8} \text{ mol} \cdot \text{l}^{-1} \cdot \text{s}^{-1}$.

**Answer 3:** The anisotropic nature of crystalline solids is due to the fact that they show different values for the physical properties like refractive index, electrical conductivity; on passing through different directions (the three dimensions) in the same crystal.

**Answer 4:** If no salt bridge were used in electrochemical cell, the metal ions $(Zn^{2+})$ formed by the loss of electrons will accumulate in one electrode and the negative ions $(SO_4^{2-})$ will accumulate in the other. Thus, the solution will develop charges and the current stops flowing. Moreover, inner circuit is not completed.
Answer 5: In CuSO$_4$.5H$_2$O, 4H$_2$O molecules are present as ligand. Crystal field splitting occurs and $d-d$ transition occurs which gives it blue colour. In CuSO$_4$, there are no H$_2$O molecules present as ligand. No crystal field splitting occurs and hence it has no colour.

Answer 6: The structure of XeO$_3$ molecule is:

![Structure of XeO$_3$](image)

Answer 7: The structural formula for isobutyl alcohol is:

CH$_3$–CH–CH$_2$OH

| CH$_3$

The IUPAC name is: 2–Methyl propane–1–ol

Answer 8: The relative ease of dehydration of alcohols is found high in tertiary alcohols and least in primary alcohols. So the order would be:

(CH$_3$)$_3$COH > (CH$_3$)$_2$CHOH > CH$_3$CH$_2$OH

“Section – B”

Answer 9: Corrosion is a redox reaction. In this reaction, simultaneous oxidation and reduction reactions takes place at cathode & anode. Because of presence of air and moisture, oxidation takes place anode. The point where oxidation takes place, it behaves as the anode.

Anode:

$$Fe_{(s)} \rightarrow Fe^{2+}_{(aq)} + 2e^-$$
Electrons released at the anodic position move through the metallic object and go to another position of the object. Presence of H ions helps the electrons to reduce molecular oxygen. This point behaves as the cathode. These H\(^+\) ions come either from H\(_2\)CO\(_3\), which are formed due to the dissolution of carbon dioxide from air into water or from the dissolution of other acidic oxides from the atmosphere in water.

Cathode:

\[ O_{2(g)} + 4H^+_{(aq)} + 4e^- \rightarrow 2H_2O_{(l)} \]

The overall reaction is:

\[ 2Fe_{(s)} + O_{2(g)} + 4H^+_{(aq)} \rightarrow 2Fe^{2+}_{(aq)} + 2H_2O_{(l)} \]

Ferrous ions are further oxidized by atmospheric oxygen to ferric ions. These ferric ions combine with moisture & forms hydrated ferric oxide i.e., rust.

**Answer 10:** Raoult’s Law: For a solution of volatile liquids, the partial pressure of each component in a solution is directly proportional to its mole fraction.

Maximum boiling azeotropes are formed by the solution showing large negative deviation from Raoult’s law form the maximum boiling azeotropes; for e.g., mixture of chloroform and acetone.

The hydrogen bond formation decreases the escaping tendency of molecules for each component and consequently the vapour pressure decreases resulting in negative deviation from Raoult’s law and thus leads to high boiling point.

**Answer 11:** The vapour pressure of the aqueous solution containing urea is less than the vapour pressure of pure water because urea is a non-volatile solute. To boil this solution we have to heat it to the temperature higher than the normal boiling point of water.

To freeze the solution the temperature is lowered, the vapour pressure of solution also lowers. The vapour pressure of solution equalizes the vapour pressure of solid solvent at temperature lower than the normal freezing point of water.
**Answer 12:** (a) The reaction mechanism is:

![Reaction Mechanism](image)

(b) The reaction mechanism for the formation of alkenes is:

![Reaction Mechanism](image)

**OR**

(a) In PCl$_5$, there is trigonal bipyramidal geometry. In this structure, the two axial P— Cl bonds are longer than the three equatorial P — Cl bonds. Thus, axial bonds are less stable. This is because of the greater bond pair - bond pair repulsion in the axial bonds. Hence, all the bonds in PCl$_5$ are not equivalent.

(b) S — S bonds are stronger as compared to O—O bonds. Thus, sulphur has a greater tendency for catenation than oxygen.

**Answer 13:** (a) As electro negativity of halogens decreases in the order F > Cl > Br, the ionic character of transition metal halides decreases in the order M – F > M – Cl > M – Br. Hence, fluorides are ionic whereas chlorides and bromides are covalent.
The change in size of the lanthanoids due to lanthanoids contraction is very small as we proceed from La (Z = 57) to Lu (Z = 71). Hence, their chemical properties are similar. Moreover, their valence shell configuration remains the same because the electrons are added into the inner 4f–subshell. Hence, they show similar characteristics.

**Answer 14:** (a) Cannizzaro Reaction: Aldehydes do not contain a α-hydrogen atom, when treated with concentrated alkali solution; undergo disproportionation, i.e., self oxidation–reduction. As a result one molecule of the aldehyde is reduced to the corresponding alcohol at the cost of the other which is oxidised to the corresponding carboxylic acid. This reaction is called Cannizzaro reaction. For example: the reaction of formaldehyde in the presence of conc. KOH leads to formation of methanol and potassium formate.

\[
\begin{align*}
\text{H}_2\text{C}=\text{O} + \text{H}_2\text{C}=\text{O} + \text{conc. KOH} & \rightarrow \text{H}_2\text{C}=\text{CH}_2 \quad \text{Methanol} \\
\text{H}_2\text{C}=\text{O} & \quad \text{Potassium formate}
\end{align*}
\]

(b) Reimer–Teimann Reaction: Treatment of phenol with chloroform in the presence of aqueous sodium or potassium hydroxide (electrophilic substitution reaction) at 340 K followed by hydrolysis of the resulting product gives salicylaldehyde. This reaction is called Reimer–Teimann reaction. The resulting product gives salicylaldehyde. This reaction is called Reimer–Teimann reaction.

\[
\begin{align*}
\text{OH} & \quad \text{Intermediate} \\
\text{CHCl}_3 + \text{aq NaOH} & \rightarrow \text{Na}^+\text{Na}^+ \\
\text{NaOH} & \rightarrow \text{H}^+ \\
\text{Salicylaldehyde}
\end{align*}
\]

**Answer 15:** (a) Aniline is a primary amine. Therefore it gives carbyamine test, i.e., when heated with an alcoholic solution of KOH and CHCl₃, it gives offensive smell of phenyl isocyanide. But N-ethyl aniline is secondary amine and hence does not give carbylamine test.
(b) N-methylpropan-2 amine is a secondary amine. On adding Hinsberg’s reagent compound is formed which is soluble in aqueous NaOH. But N-ethyl-N-methylethamine does not react with Hinsberg’s reagent.

**Answer 16:** α-form of glucose and β-form of glucose can be distinguished by the position of hydroxyl group on the first carbon atom.

In open chain β-glucose, the hydroxyl group on the first carbon atom is present towards the left side whereas in the closed ring β-glucose, the hydroxyl group on the first carbon atom is above the plane of the ring.

In open chain α-glucose, the hydroxyl group on the first carbon atom is towards the right whereas, in the closed ring α-glucose, the hydroxyl group on the first carbon atom is below the plane of the ring.

**Answer 17:** Primary structure of proteins: In this structure, each polypeptide chain of a protein has amino acids. These amino acids are linked with each other in a specific sequence.

Secondary structure of proteins: This structure refers to the shape in which a long polypeptide can exist.

There are two different secondary structures possible:

(a) Helical structure: In this, a polypeptide chain forms all possible hydrogen bonds by twisting
into a helix with —NH group of each amino acid residue and hydrogen bonded to > C = O of an adjacent turn of helix.

(b) β-pleated structure: In this, all peptide chains are stretched out to their maximum extensions and then laid side by side which are held together by intermolecular hydrogen bonds.

Answer 18: Antiseptics: They are chemical substances which prevent the growth of micro-organisms and may even kill them but are not harmful to human or animal tissues. For example, dettol and savlon. They are generally applied on wounds, cuts, ulcers and diseased skin surfaces.

Disinfectants: They are chemical substances which kill micro-organisms but are not safe to be applied to the living tissue. These are generally used to kill micro-organisms present in the drains, toilets, floors, etc. Some common examples are phenol and chlorine.

“Section - C”

Answer 19: For a fcc structure,

\[ r = \frac{a}{2\sqrt{2}} \]

\[ a = 400 \text{ pm} \quad 400 \times 10^{-10} \text{ cm} \]

\[ r = \frac{400 \times 10^{-10}}{2 \times 1.414} \]

\[ r = 141.4 \text{ pm} \]

Thus, the radius of the silver atom is 141.4 pm

Answer 20: (a)
(b) 

<table>
<thead>
<tr>
<th>( [N_2O_5] ) (M)</th>
<th>Time (min)</th>
<th>( \log [N_2O_5] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.400</td>
<td>0.00</td>
<td>-0.3979</td>
</tr>
<tr>
<td>0.289</td>
<td>20.0</td>
<td>-0.5391</td>
</tr>
<tr>
<td>0.209</td>
<td>40.0</td>
<td>-0.6798</td>
</tr>
<tr>
<td>0.151</td>
<td>60.0</td>
<td>-0.8275</td>
</tr>
<tr>
<td>0.109</td>
<td>80.0</td>
<td>-0.9725</td>
</tr>
</tbody>
</table>

From this plot,
\[
\text{Slope} = \frac{-0.70 - (-0.60)}{40 - 20} = \frac{-0.10}{20}
\]
Also, Slope of the line \( \frac{-k}{2.303} \)

Thus,
\[
k = \frac{0.10}{20} = 0.005 \\
k = 0.0115 \\
k = 1.15 \times 10^{-3}\text{min}^{-1}
\]

After 100 min,
\[
k = \frac{2.303}{100} \log \frac{0.4}{0.098} \\
k = 0.1406\text{min}^{-1}
\]

(c)
\[r = k[N_2O_5] \]
\[r = 1.15 \times 10^{-3} \times 0.4 \]
\[r = 4.6 \times 10^{-4}\text{ s}^{-1}\]
Answer 21: (a) Coagulating power of an electrolyte depends upon the charge on the ion having charge opposite to that of colloidal particles. Greater the change on the oppositely charged ion, small is its amount required for coagulation and hence greater is its coagulating power. Hence, for a positively charged sol, \( \text{PO}_4^{3-} \) ion with three units of negative charge has greater coagulating power than \( \text{Cl}^- \) ion with one unit negative charge.

(b) Yes, vital functions of the body are affected during fever. This is because biological reactions taking place in our body are catalysed by enzymes. These enzymes show maximum activity in the temperature range 298 – 310 K. During fever, when temperature rises above 310 K, enzymatic activity becomes less.

OR

(a) Ice cream is an emulsion of milk and cream in water, i.e., oil–in–water type. Gelatine is added to act as an emulsifier, i.e., it helps to stabilise the emulsion.

(b) On prolonged dialysis, even the very small amount (trace amount) of the electrolyte which stabilises the sol is completely removed. Hence, the sol becomes unstable and its coagulation takes place.

(c) Ions (either positive or negative) of peptising agent (electrolyte) are adsorbed on the particles of the precipitate. They repel and hit each other breaking the particles of the precipitate into colloidal size.

Answer 22: (a) Vapour phase refining of a metal: It is the process of refining metal by converting it into its vol-
atile compound and then, decomposing it to obtain a pure metal. To carry out this process, metal should form a volatile compound with an available reagent, and the volatile compound should be easily decomposable so that the metal can be easily recovered.

(b) Electrolytic refining: In this process, impure metals are refined through the use of electricity; by anode being made of impure metal and cathode being made of a strip of pure metal. A solution of a soluble salt of the same metal is taken as the electrolyte. When an electric current is passed, metal ions from the electrolyte are deposited at the cathode as pure metal and the impure metal from the anode dissolves into the electrolyte in the form of ions. The impurities present in the impure metal gets collected below the anode. This is known as anode mud.

Anode:
\[ M \rightarrow M^{n+} + ne^- \]

Cathode:
\[ M^{n+} + ne^- \rightarrow M \]

(c) Leaching: The powdered ore is digested with a dilute sodium cyanide while a current of air is continuously passed. As a result, silver pass into the solution forming sodium dicyanoargentate (I) while the impurities remain unaffected which are filtered off.
\[ Ag_2S + 4NaCN \rightarrow 2Na\left[Ag(CN)_2\right] + Na_2S \]
Sod. dicyanoargentate(I)

**Answer 23:**
(i) \( CH_3CH_2NH_2 + CHCl_3 + 3KOH_{(al)} \rightarrow CH_3CH_2NC + 3KCl + 3H_2O \)
(ii) \( KMnO_4 \xrightarrow{Heated} K_2MnO_4 + MnO_2 + O_2 \)
(iii) \( Cr_2O_7^{2-} + H_2S + H^+ \rightarrow 2Cr^{3+} + 7H_2O + 3S \)
Answer 24: (1) $K_4\left[ Mn(\text{CN})_6 \right]$

Name: - Potassium hexacyanomanganate (II)
Stereochemistry - Does not show geometric or optical isomerism
Magnetic behaviour — Paramagnetic

(2) $\left[ \text{Co}\left( \text{NH}_3 \right)_5 \text{Cl} \right]\text{Cl}_2$

Name - Pentaamminechloridocobalt (III) Chloride
Stereochemistry - Does not show geometric isomerism but is optically active
Magnetic behaviour - Paramagnetic

(3) $K_2\left[ \text{Ni}(\text{CN})_4 \right]$

Name - Potassium tetracyanonickelate (II)
Stereochemistry - Does not show geometric or optical isomerism
Magnetic behaviour - Diamagnetic

Answer 25: (a) Alcohols form Hydrogen-bonding with water due to the presence of $\text{–OH}$ group whereas hydrocarbons cannot form Hydrogen-bonding with water due to non-polar nature. As a result, alcohols are comparatively more soluble in water than hydrocarbons of comparable molecular masses.

(b) Because of resonance in halobenzene, C—X acquires partial double bond character. On the other hand, no resonance takes place in CH$_3$—X.

We know that, bond length of double bond is smaller than single bond. Thus, C—X bond length in halobenzene is smaller than C-X bond length in CH$_3$-X.
(c) $C_6H_5CH(C_6H_5)Br$ will be more reactive towards $S_N1$ substitution reaction because $S_N1$ substitution reaction involves the formation of a carbocation which is not affected by the presence of bulky groups.

Answer 26: (a) The basicity of amines depends on the $+I$ effect of the alkyl groups. In alkyl-amine, -CH$_3$ groups increase the electron density on the nitrogen atom and thus increases the basicity whereas in ammonia, -CH$_3$ groups are absent. Thus, alkyl-amine is more basic than ammonia.
Answer 27: (a) Tranquilizers: These are chemical substances which reduces anxiety, stress by acting on nerve centres. These drugs induce sleep and have a habit forming effect. They form an essential component of sleeping pills.

(b) Artificial sweetener: These are the compounds which are added to food to give sweet taste without increasing the calories. Examples: Saccharin, aspartame.

(c) Antihistamines: These are anti-allergic drugs and are used to treat allergy, e.g., skin rashes, conjunctivitis, nasal discharge, etc. Allergy is caused due to the liberation of histamine in the body. Example: Chloropheniramine, promethazine.

“Section – D”

Answer 28: (a)
(b) The concentration $= \frac{1.63 \times 100}{2} = 81.5 \text{ mol/l}$ is corresponds to the half life.

From the graph, we can say that the half life $= 1450 \text{ s}$.

(c)

<table>
<thead>
<tr>
<th>t(s)</th>
<th>$10^2 \times [N_2O_5] \text{ mol/l}$</th>
<th>$\log [N_2O_5]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.63</td>
<td>-1.89</td>
</tr>
<tr>
<td>400</td>
<td>1.36</td>
<td>-1.87</td>
</tr>
<tr>
<td>800</td>
<td>1.14</td>
<td>-1.95</td>
</tr>
<tr>
<td>1200</td>
<td>0.93</td>
<td>-2.03</td>
</tr>
<tr>
<td>1600</td>
<td>0.78</td>
<td>-2.11</td>
</tr>
<tr>
<td>2000</td>
<td>0.64</td>
<td>-2.19</td>
</tr>
<tr>
<td>2400</td>
<td>0.53</td>
<td>-2.28</td>
</tr>
<tr>
<td>2800</td>
<td>0.43</td>
<td>-2.37</td>
</tr>
<tr>
<td>3200</td>
<td>0.35</td>
<td>-2.46</td>
</tr>
</tbody>
</table>
(d) The plot, $\log[N_2O_5] v/s t$, is a straight line. Therefore, the given reaction is of the first order. The rate law of the reaction is

\[ \text{Rate} = k[N_2O_5] \]

(e) From the plot, we have

\[
\text{slope} = \frac{-2.46 - (-1.79)}{3200 - 0} = \frac{-0.67}{3200}
\]

Slope of the line of the plot is $= -\frac{k}{2.303}$

Thus, $\frac{k}{2.303} = \frac{0.67}{3200}$

\[ k = 4.82 \times 10^{-5} \text{ sec}^{-1} \]

(f) Half-life of the given reaction is,

\[
t_{1/2} = \frac{0.693}{k} = \frac{0.693}{4.82 \times 10^{-5}} = 1.438 \times 10^3 \text{ s}
\]

\[ = 1438 \text{ s} \]

This value, 1438 s, is very close to the value that was obtained from the graph.

OR

(a) Let the order of the reaction with respect to A is $x$ and with respect to B be $y$. 
Hence, rate of reaction will be
\[ r_0 = k[A]^x[B]^y \]

\[ 5.07 \times 10^{-5} = k[0.20]^x[0.30]^y \] ..................(1)
\[ 5.07 \times 10^{-5} = k[0.20]^x[0.10]^y \] ..................(2)
\[ 1.43 \times 10^{-4} = k[0.40]^x[0.05]^y \] ..................(3)

Dividing equation (1) by (3),
\[ \frac{5.07 \times 10^{-5}}{1.43 \times 10^{-4}} = \frac{k[0.20]^x[0.30]^y}{k[0.40]^x[0.05]^y} \]

\[ 1 = \frac{[0.30]^y}{[0.10]^y} \]
\[ [3]^y = 1 \]
\[ y = 0 \]

Dividing equation (2) by (3),
\[ \frac{1.43 \times 10^{-4}}{5.07 \times 10^{-5}} = \frac{k[0.40]^x[0.05]^y}{k[0.20]^x[0.30]^y} \]

\[ 2.821 = [2]^x \]

Taking log both sides
\[ x \log 2 = \log 2.821 \]
\[ x = 1.496 \]
\[ x \approx 1.5 \]

Thus, the order of the reaction with respect to A is 1.5 and with respect to B is zero.
(b) For a first order reaction,
\[ t = \frac{2.303}{k} \log \frac{a}{a-x} \]

At 298 K,
\[ t = \frac{2.303}{k} \log \frac{100}{90} \]
\[ = \frac{0.1054}{k} \]

At 308 K,
\[ t' = \frac{2.303}{k'} \log \frac{100}{75} \]
\[ = \frac{0.2877}{k'} \]

Now, as per the question
\[ t' = t \]
\[ \frac{0.1054}{k} = \frac{0.2877}{k'} \]
\[ \frac{k'}{k} = 2.7296 \]

From Arrhenius equation,
\[ \log \frac{k'}{k} = \frac{E_a}{2.303R} \left[ \frac{T'}{T} - \frac{T}{T'} \right] \]
\[ \log 2.7296 = \frac{E_a}{2.303 \times 8.314} \left[ \frac{308 - 298}{298 \times 308} \right] \]
\[ E_a = \frac{2.303 \times 8.314 \times 298 \times 308 \times \log 2.7296}{10} \]
\[ = 76.64 \text{ kJ/mol} \]

Now we can calculate \( k \) at 318 K,

We have \( A = 4 \times 10^{10} \text{ sec}^{-1} \)
\[ T = 318 \text{ K} \]
Again, use Arrhenius equation,

$$\log k = \log A - \frac{E_a}{2.303RT}$$

$$= \log(4 \times 10^9) - \frac{76.64 \times 10^3}{2.303 \times 8.314 \times 318}$$

$$= 10.6021 - 12.5876$$

$$= -1.9855$$

Thus,

$$k = anti \log(-1.9855) - 1.034 \times 10^{-2} \text{ sec}^{-1}$$

**Answer 29:** (i) Nitrogen can form strong hydrogen bonds because of its high electronegativity and smaller size than phosphorus which forms only very weak hydrogen bonds. As a result, NH$_3$ molecules are more strongly associated than PH$_3$. Hence, NH$_3$ has a higher boiling point compared to PH$_3$.

(ii) Sulphur due to its small size, has more tendency to form $p\pi - p\pi$ bonds. So, SO$_2$ is a discrete molecule and intermolecular forces are weak van-der Waals forces. Hence, SO$_2$ is a gas. SeO$_2$ is a solid due to less tendency of selenium to participate in multiple bond formation. Therefore, SeO$_2$ polymerizes and is a solid.
(b) The completed reactions are as follows:
\[
\begin{align*}
\text{Cu} + 2\text{H}_2\text{SO}_4 & \rightarrow \text{CuSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O} \\
3\text{SCl}_2 + 4\text{NaF} & \rightarrow \text{S}_2\text{Cl}_2 + \text{SF}_4 + 4\text{NaCl}
\end{align*}
\]

(c) \(\text{H}_2\text{SO}_4\) is a very strong acid and gives \(\text{H}^+\) ion very readily in water. Therefore, the first ionization is very high.
\[
\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{HSO}_4^- + \text{H}_3\text{O}^+
\]
But \(\text{HSO}_4^-\) (the conjugate base of \(\text{H}_2\text{SO}_4\)) is more resonance stabilized and gives second \(\text{H}^+\) ion with difficulty. Hence, \(K_{a2} \ll K_{a1}\).

OR

(a) In \(\text{NH}_3\), N is \(sp^3\) hybridized and one lone pair of electrons is present on N atom. Due to lone pair – bond pair repulsions, the H – atoms are pushed closer and the bond angles decreases from 109° to 107°. In HPH or HAsH or HSbH, the central atom uses only pure \(p\)- atomic orbital in the bond formation. As \(p\)-atomic orbitals are mutually perpendicular to each other, the bond angle is close to 90°.

(b) Basic oxides: They are the binary compounds of oxygen and electropositive metals. They are generally ionic compounds with high melting and boiling points. Example: \(\text{MgO}, \text{Na}_2\text{O}\).
Acidic oxides: They are the compounds of oxygen and non-metals. These have low melting and boiling point. Aqueous solution of these oxides turns blue litmus red. Example: \(\text{SO}_3, \text{CO}_2\).
Amphoteric oxides: They are the oxides which react with acids as well as base to form salts. Example: \(\text{Al}_2\text{O}_3, \text{ZnO}\).

(c) Ozone is formed in the stratosphere by the reaction of \(\text{O}_2\) with nascent oxygen [O] atoms which form in the stratosphere when \(\text{O}_2\) absorbs short wavelength ultraviolet radiation (less than 2.00 nm).
\[
\text{O}_2(g) + [\text{O}](g) \rightarrow \text{O}_3(g)
\]
Ozone in the stratosphere is vitally important to us. Radiations from the Sun contain ultraviolet radiation of short wavelengths, which are harmful to biological organisms. Fortunately, these...
harmful wavelengths are absorbed before they reach the surface of the earth. The most energetic are absorbed by \( O_2 \) in the earth’s upper atmosphere. Less energetic but still harmful radiation is absorbed by the ozone in the stratosphere. Ozone is an essential component of the stratosphere, a region of the atmosphere beginning at about 15 km above the earth’s surface. The high temperature in the stratosphere is responsible for the presence of ozone in this layer of atmosphere and not in the other layers of atmosphere.

**Answer 30:** (a) The compound ‘X’ which gives a product capable of being resolved into optical isomer on reaction with aq. NaOH is:

![Chemical Structure](image)

And its IUPAC name is: 2-bromobutane.

(b) The products in both the cases are:

(i) ![Chemical Structure](image)

(ii) ![Chemical Structure](image)

(c) The required products are:

(i) 

\[
\text{CH}_3\text{CHO} + \text{HCHO} \xrightarrow{\text{aq. NaOH}} \text{CH}_2 = \text{CH} \text{CHO} + \text{HCN} \xrightarrow{\text{H}^+} \text{CH}_2 \text{CH} = \text{CH} \text{COOH}
\]
(ii) $\text{HCHO} \xrightarrow{\text{CH}_3\text{MgBr} / \text{H}^+} \text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{PCl}_3} \text{CH}_3\text{CH}_2\text{Cl} \xrightarrow{\text{Na} / \text{dry ether}} \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$

OR

(a) The products that are formed by heating compounds of ether with $\text{H}^+$ are:

(i) $\text{CH}_3\text{CH} = \text{CH}_2\text{OH} + \text{CH}_3\text{CH}_2\text{I}$

(ii) $\text{CH}_3\text{CH}_2\text{OH} + \text{CH}_3\text{CH}_2 - \text{C} - \text{I}$

(iii) $\text{CH}_3\text{I} + \text{HO-} \xrightarrow{\text{HO-}} \text{HO-}$

(b) The compound A is an alcohol as it gives ester with $\text{CH}_3\text{COOH}$. Dehydrogenation of alcohol gives either an aldehyde or ketone. But compound B is an aldehyde as it is giving an acid with the same number of carbon on oxidation. As B is an aldehyde, so ‘A’ is a 1$^\text{st}$ alcohol. The structures of compound A and B are

A $\rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
B $\rightarrow \text{CH}_3\text{CH}_2\text{CHO}$
The reactions involved are:

\[
\begin{align*}
\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} & \xrightarrow{\text{Cu, H}_2} \text{CH}_3\text{CH}_2\text{CHO} \\
& \xrightarrow{\text{CH}_3\text{CO}_2\text{H}, \text{H}^+} \text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3 \\
& \xrightarrow{\text{K}_2\text{Cr}_2\text{O}_7, \text{H}_2\text{SO}_4} \text{CH}_3\text{CH}_2\text{COOH} \\
\end{align*}
\]

\[
\begin{align*}
\text{CH}_3\text{CH}_2\text{CHO} & \xrightarrow{\text{NaHSO}_3} \text{CH}_3\text{CH}_2\text{CH} - \text{OH} \\
& \xrightarrow{\text{SO}_3\text{Na}} \text{CH}_3\text{CH}_2\text{COOH}
\end{align*}
\]

(c) (i) Lower ether are soluble in water because of H–bonding between the O of ethers and the H of water. Alkanes do not participate in H–bonding.

(ii) The greater the electron density on the O, the stronger is the hydrogen–bond and the more soluble is the ether. In

\[
\text{CH}_2 = \text{CH} - \text{O} - \text{CH}_2\text{CH}_3
\]

The lone pair of oxygen is involved into resonance with double bond.

As a result, electron density on O atom decreases the tendency to form H–bond with water decreases, ultimately solubility decreases.