Q.1 The complex that can show *fac-* and *mer-*isomers is :
(1) \([\text{CoCl}_2(\text{en})_2]\)  
(2) \([\text{Co(NH}_3)_3(\text{NO}_2)_3]\)  
(3) \([\text{Pt(NH}_3)_2\text{Cl}_2]\)  
(4) \([\text{Co(NH}_3)_4\text{Cl}_2]^+\)  

Ans. [2]  
Sol. \([\text{M}_{a:b}\text{ }_3\text{-type complex compound show *fac-* and *mer-*isomer\n\\therefore [Co(NH}_3)_3(\text{NO}_2)_3]\]

Q.2 Arrange the following compounds in increasing order of C – OH bond length : methanol, phenol, p-ethoxyphenol  
(1) phenol < methanol < p-ethoxyphenol  
(2) methanol < p-ethoxyphenol < phenol  
(3) methanol < phenol < p-ethoxyphenol  
(4) phenol < p-ethoxyphenol < methanol  

Ans. [4]  
Sol.

![Resonance Diagram](https://via.placeholder.com/150)

C – OH bond length : \(\text{CH}_3 – \text{OH} > \text{P – ethoxy phenol} > \text{Phenol}\)

Q.3 Among the gases (a) – (e), the gases that cause greenhouse effect are :  
(a) \(\text{CO}_2\)  
(b) \(\text{H}_2\text{O}\)  
(c) CFCs  
(d) \(\text{O}_2\)  
(e) \(\text{O}_3\)  

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

Ans. [2]  
Sol. Except \(\text{O}_2\), \(\text{CO}_2\), \(\text{O}_3\), \(\text{H}_2\text{O}\), CFCs are green house gases
Q.4 The third ionization enthalpy is minimum for:
(1) Ni            (2) Co            (3) Mn            (4) Fe

Ans.          [4]

Sol. \( \text{Fe}^{2+} = [\text{Ar}] 3d^6 4S^2 \)
among Ni, Co, Mn, Fe
Fe having minimum third ionization energy

Q.5 A graph of vapour pressure and temperature for three different liquids X, Y, and Z is shown below:

\[ \begin{array}{c|c|c|c}
\text{Vapour pressure (mm Hg)} & 800 & 500 & 200 \\
\hline
\text{Temp (K)} & 293 & 313 & 333 & 353 \\
\end{array} \]

The following inferences are made:
(A) X has higher intermolecular interactions compared to Y.
(B) X has lower intermolecular interactions compared to Y.
(C) Z has lower intermolecular interactions compared to Y.

The correct inference(s) is / are:
(1) (C)            (2) (A) and (C)            (3) (B)            (4) (A)

Ans.          [3]

Sol. At a fixed temperature, X having more vapour pressure as compared to Y So intermolecular interaction is lower as compared to Y

Q.6 When gypsum is heated to 393 K, it forms:
(1) CaSO\(_4\) 0.5H\(_2\)O            (2) Dead burnt plaster            (3) Anhydrous CaSO\(_4\)            (4) CaSO\(_4\) 5 H\(_2\)O

Ans.          [1]

Sol. \( \text{Gypsum} \xrightarrow{393K} \text{CaSO}_4 \frac{1}{2} \text{H}_2\text{O} \)

Q.7 The major products A and B in the following reactions are:

\[ \text{CN Peroxide Heat} \Rightarrow \begin{cases} \text{[A]} & \text{[A]^+} \\ & \text{[A]} \end{cases} \]

\[ \begin{array}{c}
\text{CN} & \text{CN} & \text{CN} \\
\text{CN} & \text{CN} & \text{CN} \\
\end{array} \]

(1) A = \text{CN} and B = \text{CN}
(2) A = \text{CN} and B = \text{CN}
(3) A = \text{CN} and B = \text{CN}
(4) A = \text{CN} and B = \text{CN}
Q.8 As per Hardy-Schulze formulation, the flocculation values of the following for ferric hydroxide sol are in the order:

1. \( \text{AlCl}_3 > K_3[\text{Fe(CN)}_6] > K_2\text{CrO}_4 > K\text{Br} = K\text{NO}_3 \)
2. \( K_3[\text{Fe(CN)}_6] < K_2\text{CrO}_4 < K\text{Br} = K\text{NO}_3 = \text{AlCl}_3 \)
3. \( K_3[\text{Fe(CN)}_6] < K_2\text{CrO}_4 < \text{AlCl}_3 < K\text{Br} < K\text{NO}_3 \)
4. \( K_3[\text{Fe(CN)}_6] > \text{AlCl}_3 > K_2\text{CrO}_4 > K\text{Br} > K\text{NO}_3 \)

Ans. [2]

Sol. According to Hardy – schulze rule coagulation value \( \alpha = \frac{1}{\text{Coagulation Power}} \)

Q.9 The most suitable reagent for the given conversion is:

- (1) \( \text{LiAlH}_4 \)
- (2) \( \text{B}_2\text{H}_6 \)
- (3) \( \text{H}_2/\text{Pd} \)
- (4) \( \text{NaBH}_4 \)

Ans. [2]

Sol. Diborane (\( \text{B}_2\text{H}_6 \)) is used to reduced carboxylic acid to alcohol.

Q.10 The predominant intermolecular forces present in ethyl acetate, a liquid, are:

1. hydrogen bonding and London dispersion
2. dipole-dipole and hydrogen bonding
3. London dispersion, dipole-dipole and hydrogen bonding
4. London dispersion and dipole-dipole

Ans. [4]

Sol. Ethyl acetate \( \left( \begin{array}{c}
\text{CH}_3 \quad \text{C} \quad \text{OC}_2\text{H}_5 \\
\| \\
\text{O}
\end{array} \right) \) is polar molecule So dipole – dipole and London Forces will be present between them.
Q.11 A flask contains a mixture of isohexane and 3-methylpentane. One of the liquids boils at 63 °C while the other boils at 60 °C. What is the best way to separate the two liquids and which one will be distilled out first?
(1) fractional distillation, 3-methylpentane
(2) simple distillation, isohexane
(3) simple distillation, 3-methylpentane
(4) fractional distillation, isohexane

Ans. [4]
Sol. Isohexane and 3 Methylpentane Having same molecular formula
Isohexane boil at 60 °C and 3-Methyl pentane boil at 63 °C. Both Having low Boiling point difference So Fractional distillation is useful for separation and Isohexane Having low Boiling point So comes out first.

Q.12 The major product of the following reaction is:

![Chemical structure](image)

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

Ans. [4]
Sol. 

![Chemical structure](image)
Q.13 The stoichiometry and solubility product of a salt with the solubility curve given below is, respectively:

\[ \text{[X]/mM} \]

\[ \text{[Y]/mM} \]

(1) \( XY, 2 \times 10^{-6} \text{ M} \)

(2) \( XY_2, 1 \times 10^{-9} \text{ M} \)

(3) \( XY_2, 4 \times 10^{-9} \text{ M} \)

(4) \( X_2Y, 2 \times 10^{-9} \text{ M} \)

Ans. [3]

Sol.

\( XY_2 \rightarrow X^{2+} + 2Y^- \)

\( K_{sp} = [X^{2+}][Y^-]^2 \)

\( = (10^{-3})(2 \times 10^{-3})^2 \)

\( = 4 \times 10^{-9} \)

Q.14 The rate of a certain biochemical reaction at physiological temperature (T) occurs \( 10^6 \) times faster with enzyme than without. The change in the activation energy upon adding enzyme is:

(1) \(-6(2.303)RT\)

(2) \(+6RT\)

(3) \(-6RT\)

(4) \(+6(2.303)RT\)

Ans. [1]

Sol.

Without catalyst:

\[ K = A e^{-\frac{E_a}{RT}} \]

Presence catalyst:

\[ 10^6 K = A e^{-\frac{E_c}{RT}} \]

\[ e^{2-2} = 10^6 = e^{\left(-\frac{E_c}{RT}\right)} \]

\[ E = E_c - E = (2.303) \times 6 \]

\[ \Delta E = E_c - E = (2.303) \times 6RT \]

Q.15 The strength of an aqueous NaOH solution is most accurately determined by titrating: (Note: consider that an appropriate indicator is used)

(1) Aq. NaOH in a burette and aqueous oxalic acid in a conical flask

(2) Aq. NaOH in a burette and aqueous oxalic acid in a burette

(3) Aq. NaOH in a volumetric flask and concentrated H\(_2\)SO\(_4\) in a conical flask

(4) Aq. NaOH in a burette and concentrated H\(_2\)SO\(_4\) in a conical flask

Ans. [1]

Sol.

Aq. NaOH in a burette and aqueous oxalic acid in a conical flask
Q.16 For the Balmer series in the spectrum of H atom, \( \nu = R \frac{1}{n_1^2 - \frac{1}{n_2^2}} \), the correct statements among (I) to (IV) are:

(I) As wavelength decreases, the lines in the series converge
(II) The integer \( n_1 \) is equal to 2
(III) The lines of longest wavelength corresponds to \( n_2 = 3 \)
(IV) The ionization energy of hydrogen can be calculated from wave number of these lines

(1) (II), (III), (IV)  
(2) (I), (II), (IV)  
(3) (I), (II), (III)  
(4) (I), (II), (IV)

Ans. [3]

Sol. \( \frac{1}{\lambda} = R \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \)

For H atom \( z = 1 \)

For Balmer series \( n_1 = 2 \)
\( n_2 = 3 \) \( \therefore \) \( \frac{1}{\lambda} = R \left( \frac{1}{4} - \frac{1}{9} \right) \)
\( \frac{1}{\lambda} = R \frac{5}{36} \)
\( \lambda_{\text{max}} = \frac{36}{5R} \)

Q.17 The number of bonds between sulphur and oxygen atoms in \( \text{S}_2\text{O}_5^2^- \) and the number of bonds between sulphur and sulphur atoms in rhombic sulphur, respectively, are:

(1) 4 and 8  
(2) 4 and 6  
(3) 8 and 6  
(4) 8 and 8

Ans. [4]

Sol. \( \text{O}^- - \text{S} - \text{O} - \text{O} - \text{S} - \text{O}^- \)

number of bond between sulphur and oxygen = 8

number of bond between sulphur and sulphur = 8

Q.18 Which of the following statement is not true for glucose?

(1) Glucose exists in two crystalline forms \( \alpha \) and \( \beta \)
(2) Glucose gives Schiff’s test for aldehyde
(3) Glucose reacts with hydroxylamine to form oxime
(4) The pentaacetate of glucose does not react with hydroxylamine to give oxime

Ans. [2]

Sol. Open chain form of glucose not give Schiff’s test.
Q.19  The first ionization energy (in kJ/mol) of Na, Mg, Al and Si respectively, are :

(1) 496, 577, 786, 737  
(2) 786, 737, 577, 496  
(3) 496, 577, 737, 786  
(4) 496, 737, 577, 786

Ans. [4]  
Sol.  Order of I.E. : Na < Al < Mg < Si

\[
\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\
496 \quad 577 \quad 737 \quad 786
\]

Q.20  The decreasing order of reactivity towards dehydrohalogenation (E₁) reaction of the following compounds is :

(A) Cl

(B) Cl

(C) Cl

(D) Cl

(1) D > B > C > A  
(2) B > A > D > C  
(3) B > D > C > A  
(4) B > D > A > C

Ans. [1]  
Sol.  Order of stability : D > B > C > A

Q.21  The volume (in mL) of 0.125 M AgNO₃ required to quantitatively precipitate chloride ions in 0.3 g of

\[ \text{M}[\text{Co(NH}_3\text{)}_6\text{Cl}_3] = 267.46 \text{ g/mol} \]

\[ \text{M}\text{AgNO}_3 = 169.87 \text{ g/mol} \]

Ans. [26.92]  
Sol.  

\[
\frac{0.3 \text{ Mole of } [\text{Co(NH}_3\text{)}_6\text{Cl}_3]}{3} = \frac{0.125 \times v \times 10^{-3}}{3} \\
V = 26.92 \text{ ml}
\]
Q.22 The number of chiral centres in penicillin is ————
Ans. [3.00]
Sol. Pencillin = R – C – HN
\[ \text{CH}_3 \]
\[ \text{CH}_3 \]
\[ \text{COOH} \]
\[ \text{O} \]

Q.23 What would be the electrode potential for the given half cell reaction at pH = 5 ?

\[ 2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^- ; \ E^0_{\text{red}} = 1.23 \text{ V} \]
\( R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} ; \ \text{Temp} = 298 \text{ k} ; \ \text{oxygen under std. atm. pressure of 1 bar} \)

Ans. [1.52]
Sol. \[ E = E_0 - \frac{0.0591}{4} \log[H^+] \]
\[ E = 1.23 + 0.0591 \times \text{pH} \]
\[ E = 1.23 + 0.0591 \times (5) \]
\[ E = 1.52 \]

Q.24 The magnitude of work done by a gas that undergoes a reversible expansion along the path ABC shown in the figure is ————

[48.00]
Sol. \[ |w| = \frac{1}{2} (6 + 10) = 48 \text{ J} \]

Q.25 Ferrous sulphate heptahydrate is used to fortify foods with iron. The amount (in grams) of the salt required to achieve 10 ppm of iron in 100 kg of wheat is ————

Atomic weight : Fe = 55.85; S = 32.00; O = 16.00

Ans. [496.00]
Ans. \[ \text{PPM} = \frac{\text{Mass of Iron}}{\text{Mass of wheat}} \times 10^6 \]
\[ 10 = \frac{\text{Mass of Iron}}{100 \times 10^3} \times 10^6 \]
Mass of Fe = 1 gm
Mole of Fe = \[ \frac{1}{56} \]
FeSO\textsubscript{4} 7H\textsubscript{2}O contain = 1 mole of Fe atom
\[ \therefore \ 56 \text{ gm in } 1 \text{ mole} \]
\[ 1 \text{ gm in } \frac{1}{56} \text{ mole} \]
\[ \therefore \text{ Mass} = \frac{1}{56} \times 277.85 = 496 \text{ gm} \]