1. Match List-I with List-II.

List – I	**List – II**
Chemical Compound	Used as
(a) Sucralose	(i) Synthetic detergent
(b) Glyceryl ester of stearic acid	(ii) Artificial sweetener
(c) Sodium benzoate	(iii) Antiseptic
(d) Bithionol	(iv) Food preservative

Choose the correct match:

(1) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

(2) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

(3) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(4) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

Ans. (2)

Sol. (a) Sucralose $\longrightarrow$ Artificial sweetener

(b) Glyceryl ester of stearic acid $\longrightarrow$ Synthetic detergent

(c) Sodium benzoate $\longrightarrow$ Food preservative

(d) Bithionol $\longrightarrow$ Antiseptic

2. $\underset{Sucrose}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{Enzyme\ A} \underset{Glucose}{C_6H_{12}O_6} + \underset{Fructose}{C_6H_{12}O_6}$

$\underset{Glucose}{C_6H_{12}O_6} \xrightarrow{Enzyme\ B} -\ 2C_2H_5OH + 2CO_2$

In the above reactions, the enzyme A and enzyme B respectively are:

(1) Invertase and Amylase

(2) Amylase and Invertase

(3) Invertase and Zymase

(4) Zymase and Invertase

Ans. (3)

Sol. $C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$

$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + 2\ CO_2$

3. The correct pair(s) of the ambident nucleophiles is (are) :

(A) AgCN/KCN

(B) RCOOAg/RCOOK

(C) $AgNO_2/KNO_2$

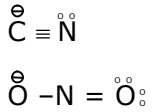
(D) AgI/KI

(1) (A) and (C) only (2) (B) only

(3) (B) and (C) only (4) (A) only

Ans. (1)

Sol.



More than one $e^{\ominus}$ donating side

4. During which of the following processes, does entropy decrease?

(A) Freezing of water to ice at 0°C

(B) Freezing of water to ice at -10°C

(C) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

(D) Adsorption of CO(g) on lead surface.

(E) Dissolution of NaCI in water

(1) (A), (B), (C) and (D) only (2) (A), (C) and (E) only

(3) (A) and (E) only (4) (B) and (C) only

Ans. (1)

Sol. A, B $\rightarrow$ Freezing of water will decrease entropy as particles will move closer and forces of attraction will increase. This leads to decrease in randomness. So entropy decrease.

C $\rightarrow$ No. of molecules decreasing

D $\rightarrow$ Adsorption will lead to decrease in randomness of gaseous particles.

E $\rightarrow$ $NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$ $\Delta S > 0$

So, (A, B, C, D) decreases entropy.

5. Match List-I with List-II :

List-I		**List-II**
(a) $[Co(NH_3)_6]\ [Cr(CN)_6]$	(i)	Linkage isomerism
(b) $[Co(NH_3)_3\ (NO_2)_3]$	(ii)	Solvate isomerism
(c) $[Cr(H_2O)_6]Cl_3$	(iii)	Co-ordination isomerism
(d) cis-$[CrCl_2(ox)_2]^{3-}$	(iv)	Optical isomerism

Choose the correct answer from the options given below:

1. (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)
2. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
3. (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)
4. (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)

Ans. (1)

Sol. Theory based

6. The common positive oxidation states for an element with atomic number 24, are:

(1) +1 and +3 (2) +1 to +6

(3) +1 and +3 to +6 (4) +2 to +6

Ans. (4)

Sol. Fact

7. The set of elements that differ in mutual relationship from those of the other sets is :

(1) Be – Al (2) Li – Na

(3) B – Si (4) Li – Mg

Ans. (2)

Sol. Li and Na does not have diagonal relationship.

8. Given below are two statements :

Statement I : 2-methylbutane on oxidation with $KMnO_4$ gives 2-methylbutan-2-ol.

Statement II : N-alkanes can be easily oxidized to corresponding alcohols with $KMnO_4$.

Choose the correct option :

(1) Both statement I and statement II are incorrect

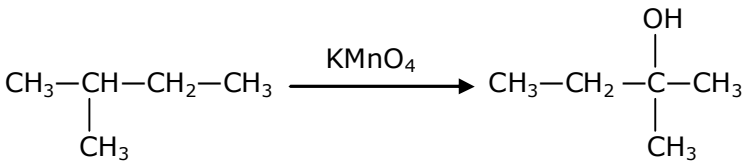
(2) Statement I is correct but statement II is incorrect

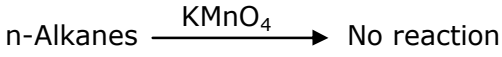
(3) Both statement I and statement II are correct

(4) Statement I is incorrect but statement II is correct

Ans. (2)

Sol.



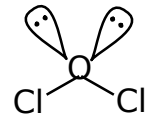


9. Amongst the following, the linear species is :

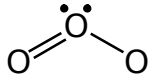
(1) N_3^- (2) Cl_2O (3) O_3 (4) NO_2

Ans. (1)

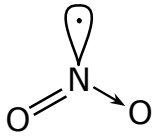
Sol. (1) $\bar{N}=\overset{+}{N}=\bar{N}$ SP(linear)

(2) 

sp^3(Bent)

(3) 

sp^2(Bent)

(4) 

sp^2(Bent)

10. For the coagulation of a negative sol, the species below, that has the highest flocculating power is :

(1) SO_4^{2-} (2) Na^+ (3) Ba^{2+} (4) PO_4^{3-}

Ans. (3)

Sol. For a negative sol, positive ion is required for flocculation.
Greater the valence of the flocculating ion added, the greater is its power to cause precipitation. This is called Hardy-Schulz law.
So, Ba^{+2} has highest flocculating power.

11. The functional groups that are responsible for the ion-exchange property of cation and anion exchange resins, respectively, are:

(1) $-SO_3H$ and $-COOH$

(2) $-SO_3H$ and $-NH_2$

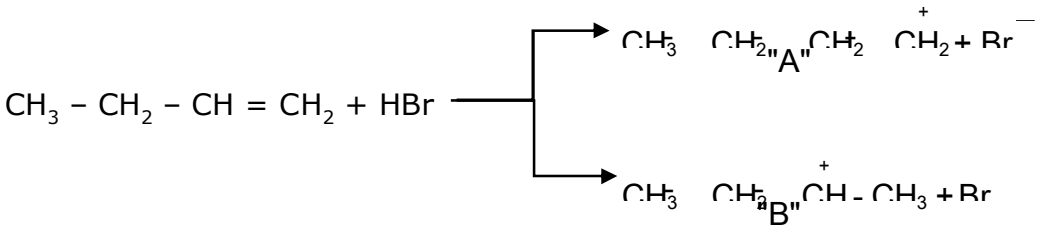
(3) $-NH_2$ and $-SO_3H$

(4) $-NH_2$ and $-COOH$

Ans. (2)

Sol. $-SO_3H$ and $-COOH$ are cation exchanger and $-NH_2$ is anion exchanger.

12. Choose the correct statement regarding the formation of carbocations A and B given.



(1) Carbocation A is more stable and formed relatively at faster rate

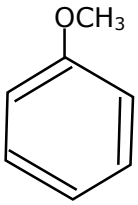
(2) Carbocation B is more stable and formed relatively at faster rate

(3) Carbocation A is more stable and formed relatively at slow rate

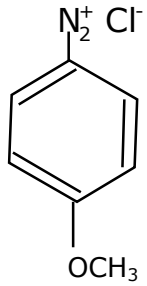
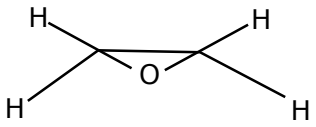
(4) Carbocation B is more stable and formed relatively at slow rate

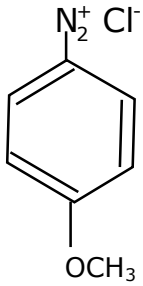
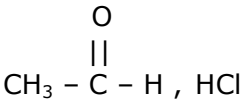
Ans. (2)

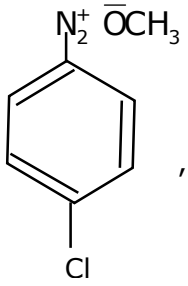
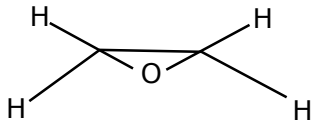
Sol. B carbocation is more stable due to more hyperconjugation & it form relatively faster rate compared to A.

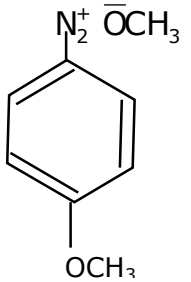
13. $\underset{(A)}{C_7H_7N_2OCl} + C_2H_5OH \longrightarrow$  $+ N_2 + \text{“X”} + \text{“Y”}$

In the above reaction, the structural formula of (A), “X” and “Y” respectively are:

(1)  ,  , H_2O

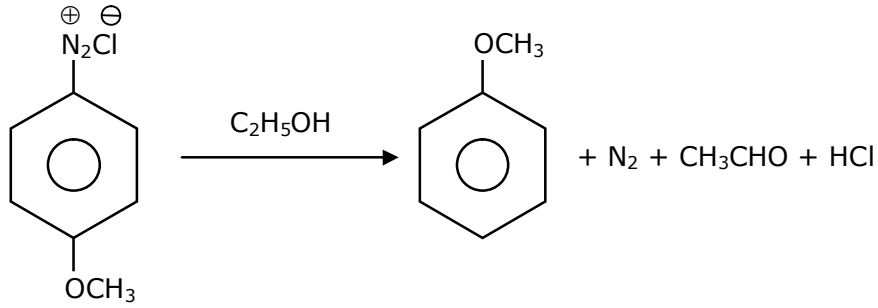
(2)  ,  , HCl

(3)  ,  , HCl

(4)  , $CH_3 - \overset{\overset{O}{\|}}{C} - H$, H_2O

Ans. (2)

Sol.



14. Fructose is an example of :

(1) Heptose

(2) Aldohexose

(3) Pyranose

(4) Ketohexose

Ans. (4)

Sol. Fructose is an example of Ketohexose.

15. Which of the following statement(s) is (are) incorrect reason for eutrophication?

(A) excess usage of fertilisers

(B) excess usage of detergents

(C) dense plant population in water bodies

(D) lack of nutrients in water bodies that prevent plant growth

Choose the most appropriate answer from the option given below :

(1) (D) only (2) (C) only

(3) (B) and (D) only (4) (A) only

Ans. (1)

Sol. Lack of nutrients in water bodies that prevent plant growth.

16. Primary, secondary and tertiary amines can be separated using :

(1) Para-Toluene sulphonyl chloride

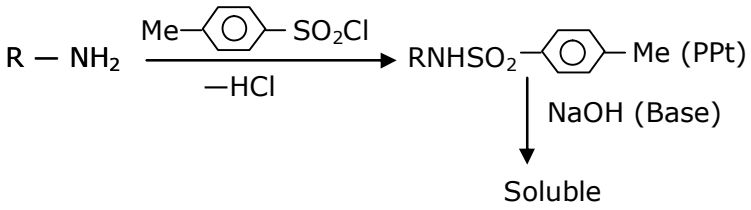
(2) Chloroform and KOH

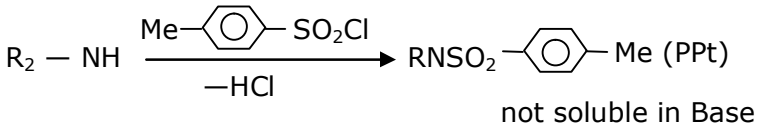
(3) Acetyl amide

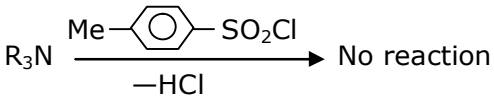
(4) Benzene sulphonic acid

Ans. (1)

Sol.







17. Match List-I with List-II

	List-I		List-II
(a)	Haematite	(i)	$Al_2O_3 \cdot xH_2O$
(b)	Bauxite	(ii)	Fe_2O_3
(c)	Magnetite	(iii)	$CuCO_3 \cdot Cu(OH)_2$
(d)	Malachite	(iv)	Fe_3O_4

Choose the correct answer from the options given below:

(1) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

(2) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

(3) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

(4) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

Ans. (4)

Sol. Fact

18. The set that represents the pair of neutral oxides of nitrogen is:

(1) NO and N_2O

(2) NO and NO_2

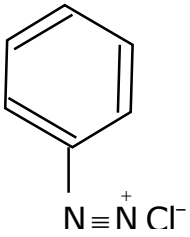
(3) N_2O and NO_2

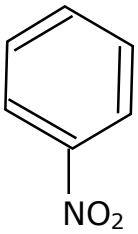
(4) N_2O and N_2O_3

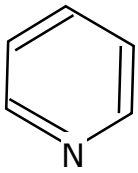
Ans. (1)

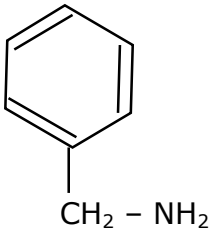
Sol. NO and N_2O are neutral oxides and N_2O_3 , NO_2 and N_2O_5 are acidic oxides.

19. Nitrogen can be estimated by Kjeldahl's method for which of the following compound?

(1) 

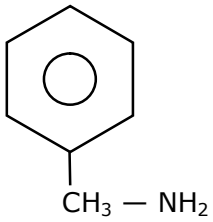
(2) 

(3) 

(4) 

Ans. (4)

Sol.



20. One of the by-products formed during the recovery of NH_3 from Solvay process is:

(1) $NaHCO_3$

(2) $Ca(OH)_2$

(3) $CaCl_2$

(4) NH_4Cl

Ans. (3)

Sol. Recovery of NH_3

$$2NH_4Cl + Ca(OH)_2 \longrightarrow \underset{\text{byproduct}}{CaCl_2} + 2NH_3 + 2H_2O$$

Section-B

1. The reaction $2A + B_2 \rightarrow 2AB$ is an elementary reaction.

For a certain quantity of reactants, if the volume of the reaction vessel is reduced by a factor of 3, the rate of the reaction increases by a factor of ……. (Round off to the Nearest Integer).

Ans. 27

Sol. For elementary reaction,

Rate of reaction = $K[A]^2 [B_2]$

Initial rate = $K\left(\frac{n_A}{V_0}\right)^2 \left(\frac{n_B}{V_0}\right)$

Final rate = $K\left(\frac{n_A}{V_0/3}\right)^2 \left(\frac{n_B}{V_0/3}\right) = 27\ K \left(\frac{n_A}{V_0}\right)\left(\frac{n_B}{V_0}\right)$

$\Rightarrow$ Final rate = 27 × Initial rate

2. In the ground state of atomic Fe(Z = 26), the spin-only magnetic moment is …….. x 10^{-1} BM. (Round off to the Nearest Integer).

[Given : $\sqrt{3} = 1.73$, $\sqrt{2} = 1.41$]

Ans. 49

Sol. Fe : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2$

In $3d^6$, no. of unpaired e^- = 4

Spin only magnetic moment = $\sqrt{n(n+2)}$

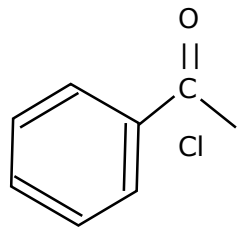
$= \sqrt{4(4+2)}$

$= \sqrt{24}$

$= 4.9$

$= 49 \times 10^{-1}$

3.



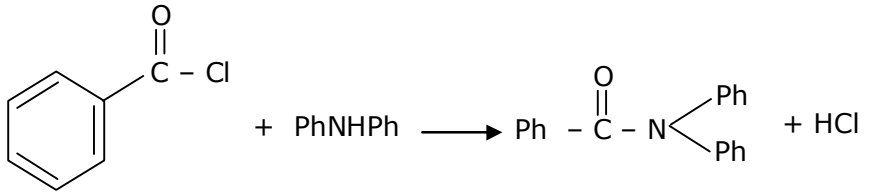
$+ C_6H_5NHC_6H_5 \longrightarrow C_6H_5 - \overset{\overset{O}{||}}{C} - N - (C_6H_5)_2$

0.140 g 0.388 g 0.210 g

Consider the above reaction. The percentage yield of amide product is ……. (Round off to the Nearest Integer)

[Given : Atomic mass : C : 12.0 u, H : 1.0 u, N : 14.0, O : 16.0 u, Cl : 35.5 u]

Ans. 77



0.14 gm 0.388 g 0.21 gm

Sol.

$\frac{0.14}{140.5}$ mol $\frac{0.388}{1600}$ mol

10^{-3} mol 2.29×10^{-3}

L.R.

Stoichiometric moles of amide = 10^{-3} mol

Actual moles of amide = 7.69×10^{-4} mol

% yield = $\frac{7.69 \times 10^{-4}}{10^{-3}} \times 100$

= 76.9%

$\simeq$ 77%

4. On complete reaction of $FeCl_3$ with oxalic acid in aqueous solution containing KOH, resulted in the formation of product A. The secondary valency of Fe in the product A is ……..

(Round off to the Nearest Integer)

Ans. (6)

Sol. $FeCl_3 + 3H_2C_2O_4 + 6KOH \longrightarrow \underset{(A)}{K_3[Fe(C_2O_4)_3]} + 3KCl + 6H_2O$

CN = 6

S.V. = C.N

5. Consider the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$. The temperature at which K_C = 20.4 and K_P = 600.1, is …… K. (Round off to the Nearest Integer).

[Assume all gases are ideal and R = 0.0831 L bar K^{-1} mol^{-1}]

Ans. 354

Sol. $K_P = K_C (RT)^{\Delta n_g}$, $\Delta n_g = 1$ (for given reaction)

$600.1 = 20.4 (RT)^1$

$\Rightarrow T \approx 354K$

6. A KCl solution of conductivity 0.14 S m^{-1} shows a resistance of 4.19 Ω inn a conductivity cell. If the same cell is filled with an HCl solution, the resistance drops 1.03 Ω. The conductivity of the HCl solution is …….. x 10^{-2} S m^{-1}. (Round off to the Nearest Integer).

Ans. 56

Sol. For KCl solution,

$$R = \left(\frac{1}{K}\right)\left(\frac{\ell}{A}\right) \Rightarrow \frac{\ell}{A} = R \times K = 4.19 \times 0.14$$

$= 0.58$

For HCl solution,

$$R = \left(\frac{1}{K}\right)\left(\frac{\ell}{A}\right)$$

$$\Rightarrow K = \frac{(\ell / A)}{R} = \frac{0.58}{1.03} = 0.56 = 56 \times 10^{-2}\ Sm^{-1}$$

Ans = 56

7. A 1 molal $K_4Fe(CN)_6$ solution has a degree of dissociation of 0.4. Its boiling point is equal to that of another solution which contains 18.1 weight percent of a non-electrolytic solute A. The molar mass of A is …… u. (Round off to the Nearest Integer).
[Density of water = 1.0 g cm^{-3}]

Ans. 85

Sol. Since boiling point is same,

$\Rightarrow$ elevation in boiling point is also same for both solution.

$$(\Delta T_B)_{K_4[Fe(CN)_6]} = (\Delta T_B)_A$$

$$\Rightarrow (ik_b\, m)_{K_4[Fe(CN)_6]} = (ik_b\, m)_A$$

$$(1 + 4\alpha) \times 1 = \frac{1 \times \frac{18.1}{M} \times 1000}{100 - 18.1}$$

$$\Rightarrow 2.6 = \frac{18.1}{M} \times \frac{1000}{81.9}$$

$\Rightarrow M = 85$

8. The number of chlorine atoms in 20 mL of chlorine gas at STP is ……10^{21}. (Round off to the Nearest Integer).
[Assume chlorine is an ideal gas at STP
R=0.083 L bar mol^{-1} K^{-1}, N_A = 6.023 x 10^{23}]

Ans. 1

Sol. $$n = \frac{PV}{RT}$$

$$= \frac{1 \times 20 \times 10^{-3}}{0.083 \times 273}$$

$$\text{No. of atoms} = \frac{1 \times 20 \times 10^{-3}}{0.083 \times 273} \times 2 \times 6.023 \times 10^{23}$$

$= 1.06 \times 10^{21}$

9. KBr is doped with 10^{-5} mole percent of $SrBr_2$. The number of cationic vacancies in 1 g of KBr crystal is …… 10^{14}. (Round off to the Nearest Integer).

[Atomic Mass : K = 39.1 u, Br = 79.9 u

$N_A = 6.023 \times 10^{23}$]

Ans. 5

Sol. For every Sr^{+2} ion, 1 cationic vacancy is created. Hence, no. of Sr^{+2} ion = Number of cationic vacancies

Since mole percentage of $SrBr_2$ dopped is 10^{-5} to that of total moles of KBr.

Hence,

No. of cationic vacancy = $\frac{10^{-5}}{100} \times \frac{1}{119} \times N_A$

= $\frac{1}{119} \times 10^{-7} \times 6.022 \times 10^{23}$

$= 5 \times 10^{-2} \times 10^{-7} \times 10^{23} = 5 \times 10^{14}$

Ans. 5

10. The total number of C–C sigma bond/s in mesityl oxide ($C_6H_{10}O$) is …… (Round off to the Nearest Integer).

Ans. (5)

Sol.