PART : CHEMISTRY

1. The froth stabiliser used in the concentration sulphide ore :
(1) fatty acid (2) pine oil (3) cresol (4) xanthate

Ans. **(3)**

Sol. In Froth floatation process, a suspension of the powdered ore is made with water. To it, collectors and froth stabilisers are added. Collectors (e. g., pine oils, fatty acids, xanthates, etc.) enhance non-wettability of the mineral particles and froth stabilisers (e. g., cresols, aniline) stabilise the froth.

2. Which of the following is a diamagnetic and low spin complex
(1) $[Co(NH_3)_6]^{3+}$ (2) $[CoCl_6]^{3-}$ (3) $[CoF_6]^{3-}$ (4) $[Fe(H_2O)_6]^{3+}$

Ans. **(1)**

Sol. In $[Co(NH_3)_6]^{3+}$, NH_3 is strong field ligand. $Co^{+3} \Rightarrow d^6 \Rightarrow t_{2g}^{2,2,2}\ e_g^{0,0}$

3. The compound which does not exist.
(1) $BeCl_2$ (2) NaO_2 (3) $PbEt_4$ (4) $(NH_4)_2BeF_4$

Ans. (2)

Sol. Alkali metals generally form oxides and peroxides.

$M + O_2 \longrightarrow M_2O$ (Oxide) $\xrightarrow{O_2}$ M_2O_2 (Peroxide)

The alkali metals tarnish in dry air due to the formation of their oxides on their surface.

$4M + O_2 \longrightarrow 2M_2O$

They react vigorously in oxygen forming following oxides.

$4\ Li + O_2 \longrightarrow 2\ Li_2O$ (Monoxide)

$2\ Na + O_2 \longrightarrow Na_2O_2$ (Peroxide)

$M + O_2 \longrightarrow MO_2$ (Superoxide) where M = K, Rb, Cs

Principal Combustion Product (Minor Product)			
Metal	**Oxide**	**Peroxide**	**Superoxide**
Li	Li_2O	(Li_2O_2)	
Na	(Na_2O)	Na_2O_2	
K			KO_2(Orange/Yellow Crystalline)
Rb			RbO_2 (Orange/Yellow Crystalline)
Cs			CsO_2 (Orange/Yellow Crystalline)

4. No. of molecules in 2.8375 L of O_2 at STP are $x \times 10^{20}$.

Ans. 762

Sol. Number of moles = $\frac{2.8375}{22.4}$ mol at STP

Number of moles = $\frac{2.8375}{22.4} \times 6.023 \times 10^{23}$

$\Rightarrow 0.1266 \times 6.023 \times 1023 \Rightarrow 7.62 \times 10^{22}$

5. Number of electron pairs in t_{2g} orbitals in potassium Ferro cyanide

Ans. (3)

Sol. $K_4[Fe(CN)_6]$

$Fe^{+2} \Rightarrow d^6 \Rightarrow t_{2g}^{2,2,2}\ e_g^{0,0}$

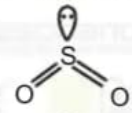
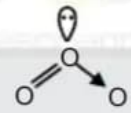
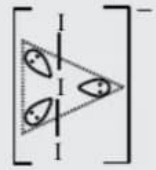
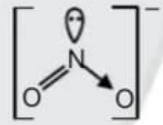
Number of electron pair in t_{2g} orbitals = 3

6. How many of the following have bent shape :

SO_2, O_3, I_3^-, N_3^-, NO_2^-

Ans. **(3)**

Sol.

Molecule/Species	Structure	Shape
SO_2		Bent
O_3		Bent
I_3^-		Linear
N_3^-	$\bar{N}=\overset{+}{N}=\bar{N}$	Linear
NO_2^-		Bent

7. $Na_2O + H_2O \longrightarrow 2X$

$Cl_2O_7 + H_2O \longrightarrow 2Y$

Find total number of oxygen atom in products X and Y

Ans. **(5)**

Sol. $Na_2O + H_2O \longrightarrow 2NaOH$

$Cl_2O_7 + H_2O \longrightarrow 2HClO_4$

$NaOH$ = 1 Oxygen – atom

$HClO_4$ = 4 Oxygen – atom

Total Oxygen – atom in X and Y = 1 + 4 = 5

8. Select the correct option.

$2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$ _____(i) ; ΔH = -x KJ/mol

$C(graphite) + O_2(g) \longrightarrow CO_2(g)$ _____(ii) ; ΔH = -y KJ/mol

Then ΔH for, $C\ (graphite) + \frac{1}{2}O_2(g) \longrightarrow CO(g)$

(1) $x - \frac{y}{2}$ (2) $\frac{x-2y}{2}$ (3) $\frac{x+2y}{2}$ (4) $\frac{x-y}{2}$

Ans. **(2)**

Sol. From equation (ii) $-\frac{(i)}{2}$ = target equation

$C(graphite) + O_2(g) \longrightarrow CO_2(g)$; $\Delta H = -y$ KJ/mol

$[2CO_2(g) \longrightarrow 2CO(g) + O_2(g)] \times \frac{1}{2}$; $\Delta H = -x$ KJ/mol $\times \frac{1}{2}$

$C(graphite) + \frac{1}{2}O_2(g) \longrightarrow CO(g)$ so $\Delta H =$

So ΔH for target equation $= -y - \left(\frac{-x}{2}\right) = -y + \frac{x}{2}$

$= \frac{x-2y}{2}$ KJ/mol

9. Find the total Number of Lone pair of electron on central atom of IF_5 and IF_7.

Ans. **(1)**

Sol.

Molecule	**Structure**	Number of Lone pair of electron on central atom
IF_5		(1)
IF_7		(0)

10. Prolong heating of ferrous ammonium sulphate solution is avoided to prevent its_____.

(1) Oxidation (2) Reduction

(3) Hydrolrolysis (4) Lecomposition

Ans. **(1)**

Sol. On Prolong heating sum ferrous ions (Fe^{+2}) Oxidised to ferric ions (Fe^{+3}). So in solution ferrous ammonium sulphate present with sum ferric ion (Fe^{+3}).

11. Enthalpy of Adsorption and Enthalpy of formation of micelle are respectively

(1) Positive (+ve) , Positive (+ve) (2) Positive (+ve), Negative (–ve)

(3) Negative (–ve), Positive (+ve) (4) Negative (–ve), Negative (–ve)

Ans. **(3)**

Sol. **Enthalpy of Adsorption is negative** because attraction force increases in Adsorption. **Enthalpy of formation of micelle is positive** because formation of micelle decreases the stability of colloids so Energy of mixture increases i.e $\Delta H > 0$.

12. The degree of dissociation of monobasic acid is 0.3. By what percent is the observed depression in freezing point greater than the calculated depression in freezing point.

Ans. **(30)**

Sol. For calculated value ΔT_f

$(\Delta T_f) = K_f \times m$

For observed value of ΔT_f

$\Delta T_f = i[K_f \times m]$

$i = 1 + (n - 1)\alpha$

$i = 1 + (2 - 1)\ 0.2$

$i = 1.3$

$(\Delta T_f)_{observed} = 1.3[K_f \times m]$

% greater than observed $\Delta T_f = \frac{(\Delta T_f)_{observed} - (\Delta T_f)_{Calculated}}{(\Delta T_f)_{Calculated}} \times 100 = 0.3 \times 100 = 30\ \%$

13. From following Latimar diagram

$FeO_4^{2-} \xrightarrow{2.20\ V} Fe^{3+} \xrightarrow{0.7\ V} Fe^{2+} \xrightarrow{-0.4\ V} Fe$

The E^0 value of $E^0_{FeO_4^{2-}/Fe^{2+}}$ = _____ $\times 10^{-3}$ V

Ans. **(1825)**

Sol. $FeO_4^{2-} + 8H^+ + 3e^- \longrightarrow Fe^{3+} + 4H_2O \quad E_1^0 = 2.20\ V \quad \Delta G_1^0 = -3F(2.20)$

$Fe^{3+} + e^- \longrightarrow Fe^{2+} \quad E_2^0 = 0.7\ V \quad \Delta G_2^0 = -1 \times F(0.7)$

Target eq.

$FeO_4^{2-} + 8H^+ + 4e^- \longrightarrow Fe^{2+} + 4H_2O \quad E_3^0 = ? \quad \Delta G_3^0 = -4 \times F(E_3^0)$

Target eq. = $eq_1 + eq_2$

$-4F\ E_3^0 = -3F \times 2.20 - 1 \times F\ (0.7)$

$E_3^0 = \left[\frac{3 \times 2.20 + 0.7}{4}\right] = 1.825 = 1.825 \times 10^{-3}$ V

14. $C(graphite) + H_2O \xrightarrow{Temp\ T_1} CO(g) + H_2(g)$

$CO(g) + H_2O(g) \xrightarrow[Catalyst]{Temp\ T_1} CO_2(g) + H_2(g)$

then relation between temperature T_1 & T_2 is

(1) $T_1 = T_2$ (2) $T_1 > T_2$

(3) $T_2 > T_1$ (4) $T_1 = 100k$, $T_2 = 1270k$

Ans. **(2)**

Sol. $C(s) + H_2O(g) \xrightarrow[T_1]{1270K} \underset{Water\ gas}{CO(g) + H_2(g)}$

$CO(g) + H_2O(g) \xrightarrow[Catalyst]{673K} CO_2(g) + H_2(g)$

so $(T_1 > T_2)$

15. **Statement – I :** Potassium dichromate is used as primary standard in volumetric analysis.

Statement – II : $K_2Cr_2O_7$ is more soluble in water than $Na_2Cr_2O_7$.

identify the correct statement.

(1) Statement–I is correct and Statement – II is incorrect.

(2) Statement-I is incorrect and Statement-II is correct.

(3) Both statement-I and statement-II are correct.

(4) Both statement-I and statement-II are incorrect.

Ans. **(1)**

Sol. (i) Potassium dichromate is used as a primary standard in volumetric analysis.
(ii) $K_2Cr_2O_7$ is less soluble in water than $Na_2Cr_2O_7$.
sodium salt has a greater solubility in water and is extensively used as an oxidising agent in organic chemistry.

16. An ideal gas is stored in a closed container at pressure 940.3 mm of Hg, if the volume of gas is reduced by 40% of its initial value at a constant temperature, then final pressure of gas is _____ mm of Hg. [nearest integer]

Ans. **1567**

Sol. For ideal gas at constant temperature.
$P_1V_1 = P_2V_2$
$940.3 \times V = P_2\,[0.6V]$

$$P_2 = \left(\frac{940.3}{0.6}\right)$$

$= 1567.16$

17. Angular momentum of an electron in a Bohr's orbit is L then change in angular momentum in 2nd orbit of hydrogen atom is
(1) L (2) 2L (3) 0 (4) 0.5L

Ans. **(1)**

Sol. angular momentum (mvr) = $\frac{nh}{2\pi}$

in Bohr's orbit (L) = $\frac{h}{2\pi}$

in 2nd Bohr's orbit of hydrogen = $\frac{2h}{2\pi} = 2L$

change in momentum = L

18. One which does not stabilize secondary and tertiary protein?
(1) O–O linkage (2) S–S linkage
(3) Vander Waal's force's (4) Hydrogen bonding

Ans. **(1)**

Sol. The main forces which stabilise the 2° and 3° structures of proteins are hydrogen bonds, disulphide linkages, van der Waals and electrostatic forces of attraction.

19. Match the following :

	List-I		List-II
(A)	Buna-N	(i)	Polyester
(B)	Dacron	(ii)	Synthetic rubber
(C)	Nylon-2-Nylon-6	(iii)	Phenol formaldehyde resin
(D)	Thermosetting polymer	(iv)	Biodegradable polymer

(1) (A) – (ii) ; (B) – (iv) ; (C) – (i) ; (D) – (iii)
(2) (A) – (iii) ; (B) – (ii) ; (C) – (iv) ; (D) – (i)
(3) (A) – (ii) ; (B) – (i) ; (C) – (iv) ; (D) – (iii)
(4) (A) – (iv) ; (B) – (ii) ; (C) – (i) ; (D) – (iii)

Ans. **(3)**

Sol. Theory based.

20. Match the following :

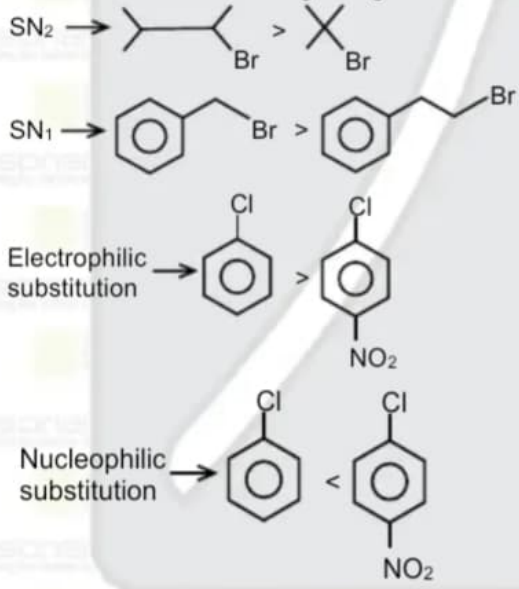
	Column-A		Column-B
(A)	Steel industry	(i)	Fly ash
(B)	Thermal power plant	(ii)	Gypsum
(C)	Fertilizer	(iii)	Slage
(D)	Paper mills	(iv)	Biodegradable

(1) (A) – (i) ; (B) – (ii) ; (C) – (iii) ; (D) – (iv)
(2) (A) – (iii) ; (B) – (i) ; (C) – (ii) ; (D) – (iv)
(3) (A) – (iv) ; (B) – (i) ; (C) – (ii) ; (D) – (iii)
(4) (A) – (iv) ; (B) – (ii) ; (C) – (i) ; (D) – (iii)

Ans. **(2)**

Sol. Biodegradable wastes are generated by cotton mills, food processing units, paper mills, and textile factories.
Non-biodegradable wastes are generated by thermal power plants which produce fly ash; integrated iron and steel plants which produce blast furnace slag and steel melting slag.
Fertilizer industries produce gypsum.

21. Choose True/False for regarding reaction information given below :



(1) TTFT (2) TTTT (3) FFTT (4) TFTT

Ans. **(1)**

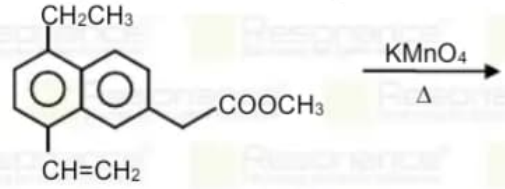
Sol. Reactivity of $SN^2 \propto \frac{1}{\text{Steric Crowding}}$ $(1^\circ > 2^\circ > 3^\circ)$ halide.

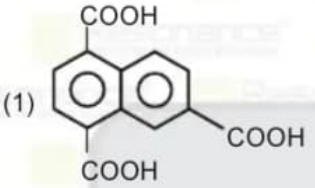
Reactivity of $SN^1 \propto$ Stability of carbocation.

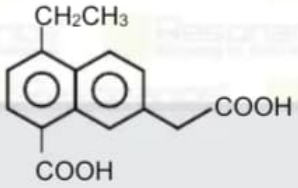
Reactivity of E.S.R. $\propto$ Electron density.

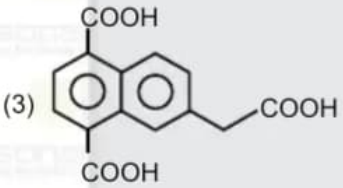
Reactivity of N.S.R. $\propto \frac{1}{\text{Electron density}}$.

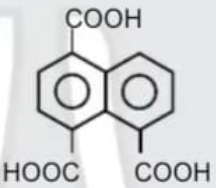
22. Final product of the following reaction:



(1) 

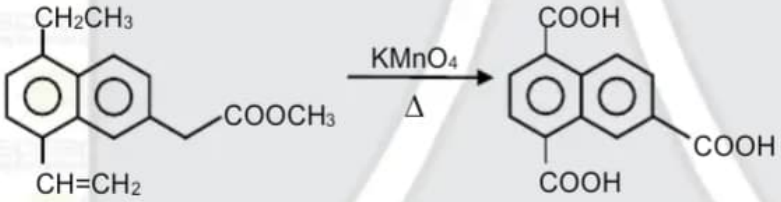
(2) 

(3) 

(4) 

Ans. **(1)**

Sol. Benzylic carbon gets oxidised into carboxylic acid in presence of $KMnO_4$ and heat.



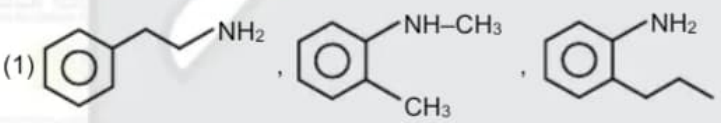
23. Use the following information and choose correct option for P, Q, R.

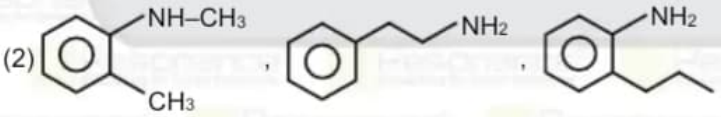
P – Prepare by the Gabriel phthalimide synthesis.

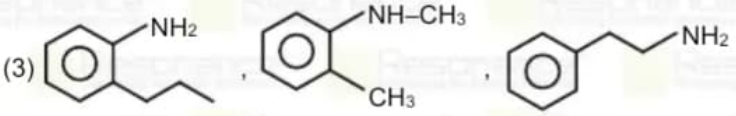
Q – React with Hinsberg reagent but not soluble in NaOH.

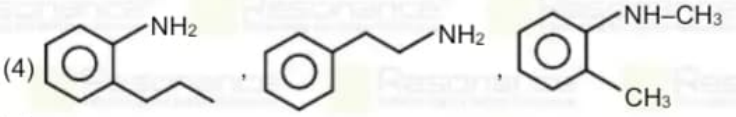
R – React with Nitrous acid and give Red dye with β-Napthol.

(P) (Q) (R)

(1) 

(2) 

(3) 

(4) 

Ans. **(1)**

Sol. (P) Gabriel synthesis is used for the preparation of aliphatic primary amines. Aromatic primary amines cannot be prepared by this method.

(Q) 2° amine react with Hinsberg reagent but not soluble in NaOH.

(R) Aromatic amines react with nitrous acid at low temperatures (273-278 K) to form diazonium salts, which form red/orange dye with β-Napthol.

24. During the column chromatography in mixture of A and B. A is first eluted: then choose correct option regarding B.

(1) Low R_F value and Stronger adsorption.

(2) High R_F value and Stronger adsorption.

(3) Low R_F value and Weak adsorption.

(4) High R_F value and Weak adsorption.

Ans. **(1)**

Sol. If any component eluted first means its R_F value is low and its **adsorption** is stronger.

$$R_F = \frac{\text{distance covered by component baseline}}{\text{total distance converd by solvent from baseline}}$$

25. Suitable reagent for the formation of phenyl methyl ether.

(1) $PhO^{\ominus}Na^{\oplus} + CH_3OH$ (2) $PhO^{\ominus}Na^{\oplus} + CH_3Br$

(3) $PhBr + CH_3O^{\ominus}Na^{\oplus}$ (4) $PhO^{\ominus}Na^{\oplus} + CH_3^{-}Na^{\ominus}$

Ans. **(2)**

Sol. C_6H_5ONa (Sodium phenoxide) $\xrightarrow[\text{Methyl bromide}]{CH_3Br}$ $C_6H_5OCH_3$ (Ansole)

This reaction is Williamson's reaction and it is used for the preparation of simple as well as mixed ethers.