

FINAL JEE(Advanced) EXAMINATION - 2022

(Held On Sunday 28th AUGUST, 2022)

PAPER-1

TEST PAPER WITH SOLUTION

CHEMISTRY

SECTION-1 : (Maximum Marks : 24)

- This section contains **EIGHT (08)** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks	: +3	ONLY if the correct numerical value is entered;
Zero Marks	: 0	In all other cases.

1. 2 mol of Hg(g) is combusted in a fixed volume bomb calorimeter with excess of O₂ at 298 K and 1 atm into HgO(s). During the reaction, temperature increases from 298.0 K to 312.8 K. If heat capacity of the bomb calorimeter and enthalpy of formation of Hg(g) are 20.00 kJ K⁻¹ and 61.32 kJ mol⁻¹ at 298 K, respectively, the calculated standard molar enthalpy of formation of HgO(s) at 298 K is X kJ mol⁻¹. The value of |X| is _____.
- [Given : Gas constant R = 8.3 J K⁻¹ mol⁻¹]

Ans. (90.39)

Sol. $Q_{\text{rxn}} = C\Delta T$

$$|\Delta U| \times 2 = 20 \times 14.8$$

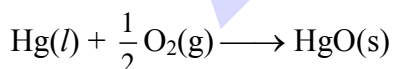
$$|\Delta U| = 148 \text{ kJ/mol}$$

$$\Delta U = -148 \text{ kJ/mol}$$



$$\Delta H = \Delta U + \Delta n_g RT$$

$$= -148 - \frac{3}{2} \times \frac{8.3}{1000} \times 298 = -151.7101$$



$$\Delta H = -151.7101 + 61.32 = -90.39 \text{ kJ/mol}$$

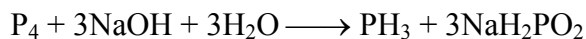
Ans. 90.39

5. Dissolving 1.24 g of white phosphorous in boiling NaOH solution in an inert atmosphere gives a gas Q. The amount of CuSO₄ (in g) required to completely consume the gas Q is _____.

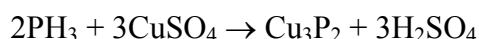
[Given : Atomic mass of H = 1, O = 16, Na = 23, P = 31, S = 32, Cu = 63]

Ans. (2.38 / 2.39)

Sol. Mole of P₄ = $\frac{1.24}{31 \times 4} = 0.01$



0.01 mole 0.01 mole



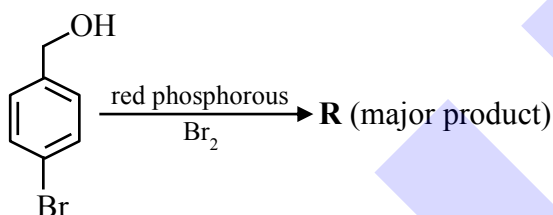
0.01 $\frac{3}{2} \times 0.01$

= $\frac{0.03}{2}$ moles

$W_{CuSO_4} = \frac{0.03}{2} \times 159 = 2.385$ gm

Ans. = 2.38 or 2.39

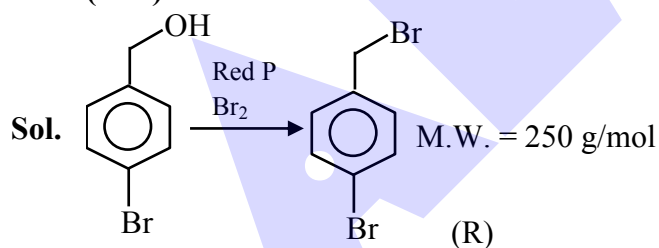
6. Consider the following reaction.



On estimation of bromine in 1.00 g of R using Carius method, the amount of AgBr formed (in g) is

[Given : Atomic mass of H = 1, C = 12, O = 16, P = 31, Br = 80, Ag = 108]

Ans. (1.50)



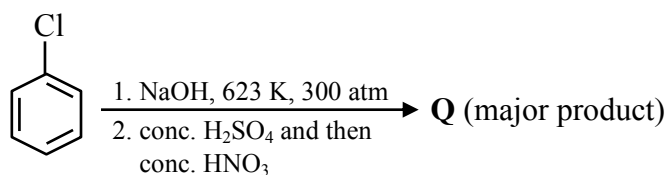
1g R $\rightarrow \frac{1}{250}$ moles

No. of Br Atoms $\rightarrow \frac{2}{250}$ moles

Moles of AgBr $\rightarrow \frac{2}{250}$ moles

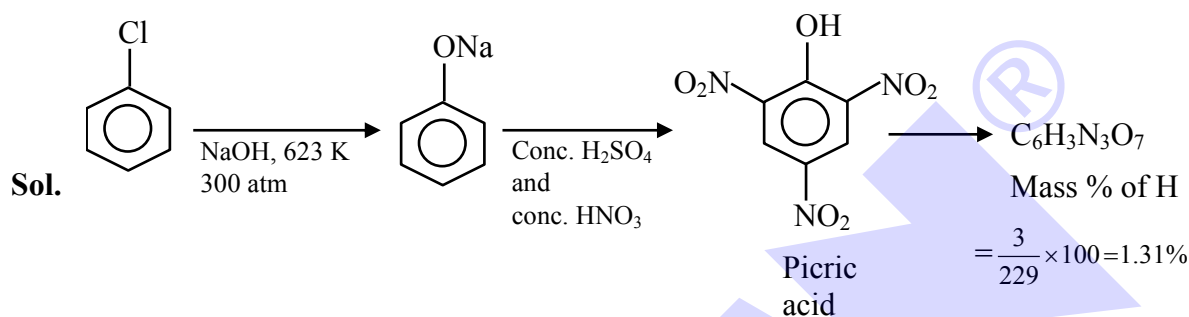
Mass of AgBr = $\frac{2}{250} \times (108 + 80) = 1.504$

7. The weight percentage of hydrogen in **Q**, formed in the following reaction sequence, is _____.

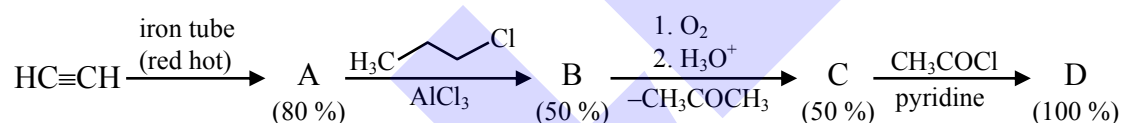


[Given : Atomic mass of H = 1, C = 12, N = 14, O = 16, S = 32, Cl = 35]

Ans. (1.31)



8. If the reaction sequence given below is carried out with 15 moles of acetylene, the amount of the product **D** formed (in g) is _____.

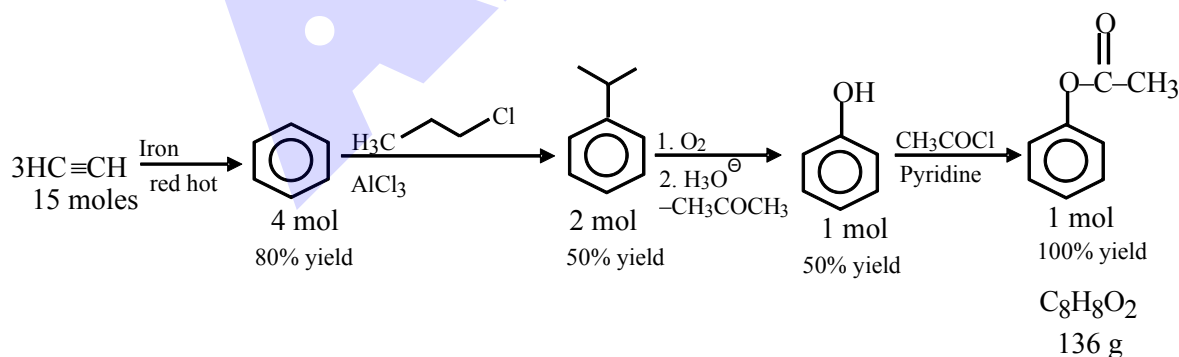


The yields of **A**, **B**, **C** and **D** are given in parentheses.

[Given : Atomic mass of H = 1, C = 12, O = 16, Cl = 35]

Ans. (136)

Sol.



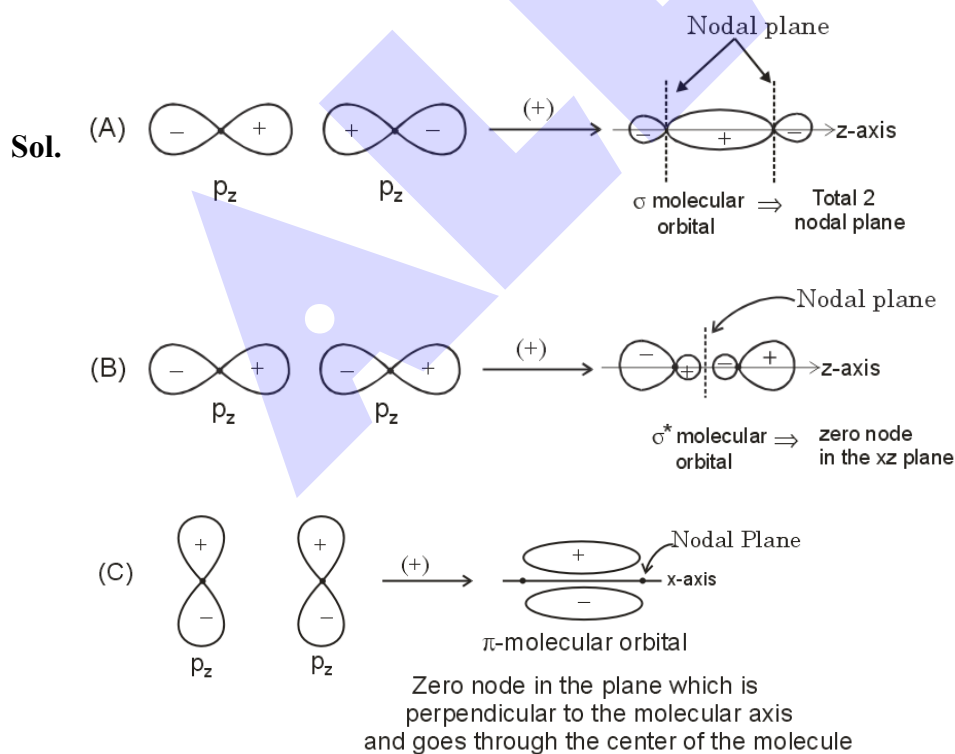
SECTION-2 : (Maximum Marks : 24)

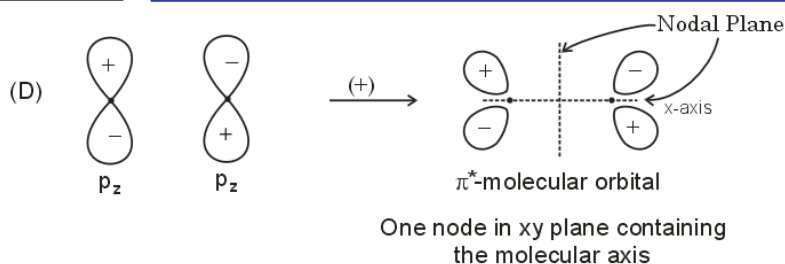
- This section contains **SIX (06)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks	: +4	ONLY if (all) the correct option(s) is(are) chosen;
Partial Marks	: +3	If all the four options are correct but ONLY three options are chosen;
Partial Marks	: +2	If three or more options are correct but ONLY two options are chosen, both of which are correct;
Partial Marks	: +1	If two or more options are correct but ONLY one option is chosen and it is a correct option;
Zero Marks	: 0	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	: -2	In all other cases.

9. For diatomic molecules, the correct statement(s) about the molecular orbitals formed by the overlap to two $2p_z$ orbitals is(are)
- (A) σ orbital has a total of two nodal planes.
- (B) σ^* orbital has one node in the xz -plane containing the molecular axis.
- (C) π orbital has one node in the plane which is perpendicular to the molecular axis and goes through the center of the molecule.
- (D) π^* orbital has one node in the xy -plane containing the molecular axis.

Ans. (A,D)





10. The correct option(s) related to adsorption processes is(are)

- (A) Chemisorption results in a unimolecular layer.
- (B) The enthalpy change during physisorption is in the range of 100 to 140 kJ mol⁻¹.
- (C) Chemisorption is an endothermic process.
- (D) Lowering the temperature favors physisorption processes.

Ans. (A,D)

Sol. (A) Chemisorption is unimolecular layered.

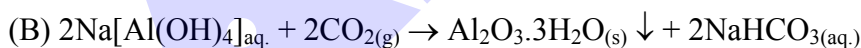
- (B) Enthalpy of physisorption is much less in magnitude.
- (C) Chemisorption of gases on solids is exothermic.
- (D) As physisorption is exothermic so lowering temperature favours it.

11. The electrochemical extraction of aluminum from bauxite ore involves.

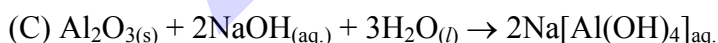
- (A) the reaction of Al₂O₃ with coke (C) at a temperature > 2500°C.
- (B) the neutralization of aluminate solution by passing CO₂ gas to precipitate hydrated alumina (Al₂O₃·3H₂O)
- (C) the dissolution of Al₂O₃ in hot aqueous NaOH.
- (D) the electrolysis of Al₂O₃ mixed with Na₃AlF₆ to give Al and CO₂.

Ans. (B,C,D)

Sol. (A) Electrochemical extraction of Aluminum from bauxite done below 2500°C



The sodium aluminate present in solution is neutralised by passing CO₂ gas and hydrated Al₂O₃ is precipitated.



Concentration of bauxite is carried out by heating the powdered ore with hot concentrated solution of NaOH

(D) In metallurgy of aluminum, Al₂O₃ is mixed with Na₃AlF₆

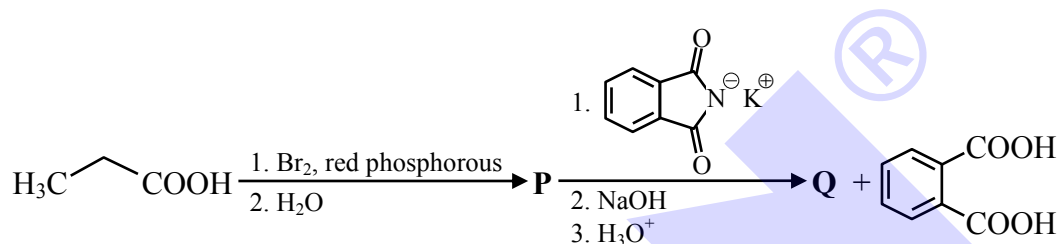
12. The treatment of galena with HNO_3 produces a gas that is
- (A) paramagnetic (B) bent in geometry
(C) an acidic oxide (D) colorless

Ans. (A,D)



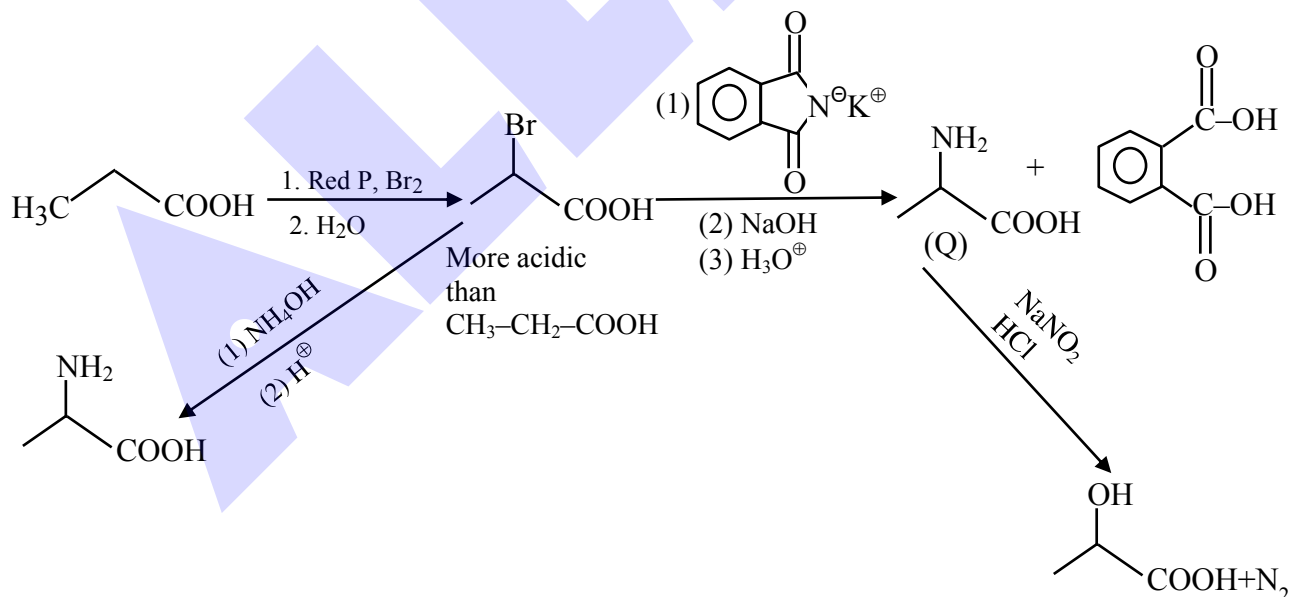
$\text{NO} \Rightarrow$ Neutral oxide, Paramagnetic, Linear geometry, Colourless gas

13. Considering the reaction sequence given below, the correct statement(s) is(are)



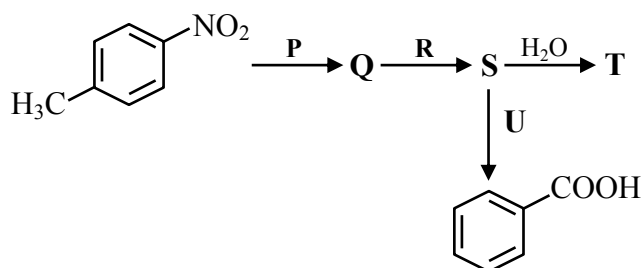
- (A) **P** can be reduced to a primary alcohol using NaBH_4 .
 (B) Treating **P** with conc. NH_4OH solution followed by acidification gives **Q**.
 (C) Treating **Q** with a solution of NaNO_2 in aq. HCl liberates N_2 .
 (D) **P** is more acidic than $\text{CH}_3\text{CH}_2\text{COOH}$.

Ans. (B,C,D)



Sol.

14. Consider the following reaction sequence,



the correct option(s) is(are)

(A) $P = H_2/Pd$, ethanol

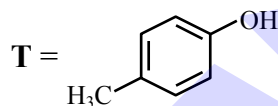
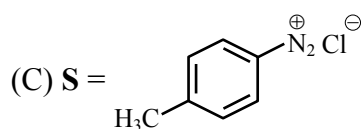
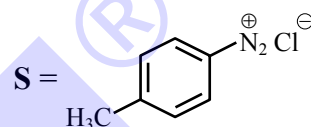
$R = NaNO_2/HCl$

$U = 1. H_3PO_2$

2. $KMnO_4 - KOH$, heat

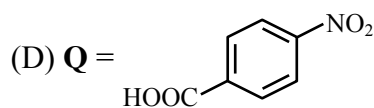
(B) $P = Sn/HCl$

$R = HNO_2$

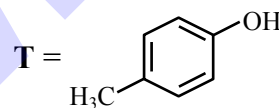


$U = 1. CH_3CH_2OH$

2. $KMnO_4 - KOH$, heat

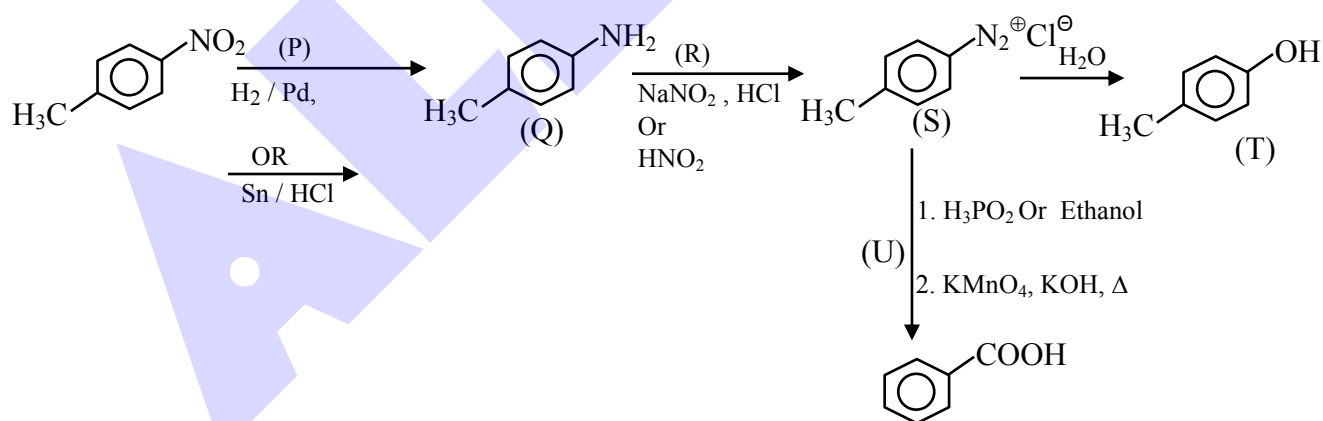


$R = H_2/Pd$, ethanol



Ans. (A,B,C)

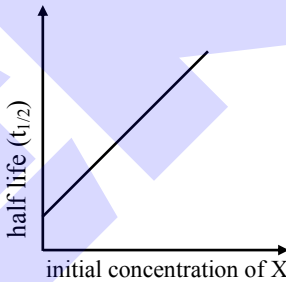
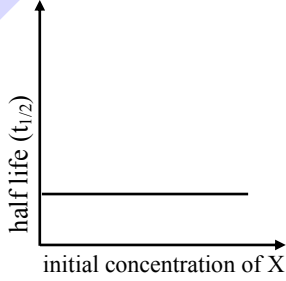
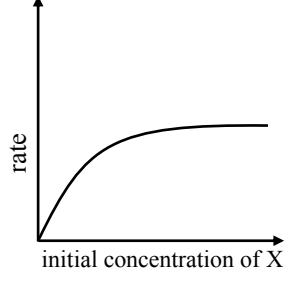
Sol.

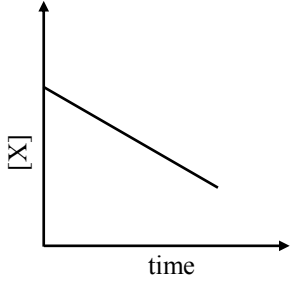
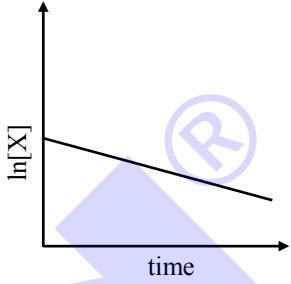


SECTION-3 : (Maximum Marks : 12)

- This section contains **FOUR (04)** Matching List Sets.
- Each set has **ONE** Multiple Choice Question.
- Each set has **TWO** lists : **List-I** and **List-II**.
- **List-I** has **Four** entries (I), (II), (III) and (IV) and **List-II** has **Five** entries (P), (Q), (R), (S) and (T).
- **FOUR** options are given in each Multiple Choice Question based on **List-I** and **List-II** and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +3 **ONLY** if the option corresponding to the correct combination is chosen;
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);
Negative Marks : -1 In all other cases.

15. Match the rate expressions in LIST-I for the decomposition of X with the corresponding profiles provided in LIST-II. X_s and k constants having appropriate units.

LIST-I	LIST-II
(I) $\text{rate} = \frac{k[X]}{X_s + [X]}$ under all possible initial concentration of X	(P) 
(II) $\text{rate} = \frac{k[X]}{X_s + [X]}$ where initial concentration of X are much less than X_s	(Q) 
(III) $\text{rate} = \frac{k[X]}{X_s + [X]}$ where initial concentration of X are much higher than X_s	(R) 

<p>(IV)</p> $\text{rate} = \frac{k[X]^2}{X_s + [X]}$ <p>where initial concentration of X is much higher than X_s</p>	<p>(S)</p> 
	<p>(T)</p> 

- (A) I \rightarrow P; II \rightarrow Q; III \rightarrow S; IV \rightarrow T
 (B) I \rightarrow R; II \rightarrow S; III \rightarrow S; IV \rightarrow T
 (C) I \rightarrow P; II \rightarrow Q; III \rightarrow Q; IV \rightarrow R
 (D) I \rightarrow R; II \rightarrow S; III \rightarrow Q; IV \rightarrow R

Ans. (A)

- Sol. (I) $\text{rate} = \frac{k[x]}{x_s + [x]} = \frac{k}{\frac{x_s}{[x]} + 1}$
 If $[x] \rightarrow \infty \Rightarrow \text{rate} \rightarrow k \Rightarrow \text{order} = 0$
 \Rightarrow (I) – (R), (P)
- (II) $[x] \ll x_s \Rightarrow \text{rate} = \frac{k[x]}{x_s} \Rightarrow \text{order} = 1$
 \Rightarrow (II) – (Q), (T)
- (III) $[x] \gg x_s \Rightarrow \text{rate} = k \Rightarrow \text{order} = 0$
 \Rightarrow (III) – (P), (S)
- (IV) $\text{rate} = \frac{k[x]^2}{x_s + [x]}$
 $[x] \gg x_s \Rightarrow \text{rate} = k[x]$
 \Rightarrow (IV) – (Q), (T)

Ans. (A)

16. LIST-I contains compounds and LIST-II contains reaction

LIST-I	LIST-II
(I) H_2O_2	(P) $\text{Mg}(\text{HCO}_3)_2 + \text{Ca}(\text{OH})_2 \rightarrow$
(II) $\text{Mg}(\text{OH})_2$	(Q) $\text{BaO}_2 + \text{H}_2\text{SO}_4 \rightarrow$
(III) BaCl_2	(R) $\text{Ca}(\text{OH})_2 + \text{MgCl}_2$
(IV) CaCO_3	(S) $\text{BaO}_2 + \text{HCl} \rightarrow$
	(T) $\text{Ca}(\text{HCO}_3)_2 + \text{Ca}(\text{OH})_2 \rightarrow$

Match each compound in LIST – I with its formation reaction(s) in LIST-II, and choose the correct option

- (A) I \rightarrow Q; II \rightarrow P; III \rightarrow S; IV \rightarrow R
 (B) I \rightarrow T; II \rightarrow P; III \rightarrow Q; IV \rightarrow R
 (C) I \rightarrow T; II \rightarrow R; III \rightarrow Q; IV \rightarrow P
 (D) I \rightarrow Q; II \rightarrow R; III \rightarrow S; IV \rightarrow P

Ans. (D)

Sol. (P) $\text{Mg}(\text{HCO}_3)_2 + 2\text{Ca}(\text{OH})_2 \rightarrow \text{Mg}(\text{OH})_2 + 2\text{CaCO}_3 + 2\text{H}_2\text{O}$

(Q) $\text{BaO}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{O}_2 + \text{BaSO}_4$

(R) $\text{Ca}(\text{OH})_2 + \text{MgCl}_2 \rightarrow \text{Mg}(\text{OH})_2 + \text{CaCl}_2$

(S) $\text{BaO}_2 + 2\text{HCl} \rightarrow \text{BaCl}_2 + \text{H}_2\text{O}_2$

(T) $\text{Ca}(\text{HCO}_3)_2 + \text{Ca}(\text{OH})_2 \rightarrow 2\text{CaCO}_3 + 2\text{H}_2\text{O}$

17. LIST-I contains metal species and LIST-II contains their properties.

LIST-I	LIST-II
(I) $[\text{Cr}(\text{CN})_6]^{4-}$	(P) t_{2g} orbitals contain 4 electrons
(II) $[\text{RuCl}_6]^{2-}$	(Q) $\mu(\text{spin-only}) = 4.9 \text{ BM}$
(III) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$	(R) low spin complex ion
(IV) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$	(S) metal ion in 4+ oxidation state
	(T) d^4 species

[Given : Atomic number of Cr = 24, Ru = 44, Fe = 26]

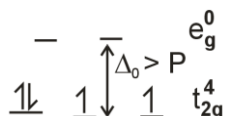
Match each metal species in LIST-I with their properties in LIST-II, and choose the correct option

- (A) I \rightarrow R, T; II \rightarrow P, S; III \rightarrow Q, T; IV \rightarrow P, Q
 (B) I \rightarrow R, S; II \rightarrow P, T; III \rightarrow P, Q; IV \rightarrow Q, T
 (C) I \rightarrow P, R; II \rightarrow R, S; III \rightarrow R, T; IV \rightarrow P, T
 (D) I \rightarrow Q, T; II \rightarrow S, T; III \rightarrow P, T; IV \rightarrow Q, R

Ans. (A)

Sol. (1) $[\text{Cr}(\text{CN})_6]^{4-}$

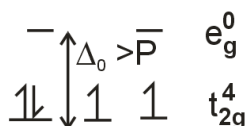
$\text{Cr}^{+2} = [\text{Ar}]_{18} 3d^4 4s^0$; low spin complex



P,R,T

(2) $[\text{RuCl}_6]^{2-}$

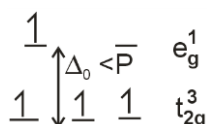
$\text{Ru}^{+4} = [\text{Kr}]_{36} 4d^4 5s^0$; low spin complex



P,R,S,T

(3) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$

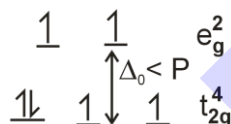
$\text{Cr}^{+2} = [\text{Ar}]_{18} 3d^4 4s^0$; high spin complex



Q,T

(4) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$

$\text{Fe}^{+2} = [\text{Ar}]_{18} 3d^6$; High spin complex



P,Q

18. Match the compounds in LIST-I with the observation in LIST-II, and choose the correct option.

LIST-I

(I) Aniline

(II) o-Cresol

(III) Cysteine

LIST-II

(P) Sodium fusion extract of the compound on boiling with FeSO_4 , followed by acidification with conc. H_2SO_4 , gives Prussian blue color.

(Q) Sodium fusion extract of the compound on treatment with sodium nitroprusside gives blood red color.

(R) Addition of the compound to a saturated solution of NaHCO_3 results in effervescence.

(IV) Coprolactam

(S) The compound reacts with bromine water to give a white precipitate.

(T) Treating the compound with neutral FeCl_3 solution produces violet color.

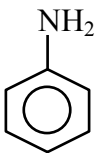
(A) I \rightarrow P, Q; II \rightarrow S; III \rightarrow Q, R; IV \rightarrow P

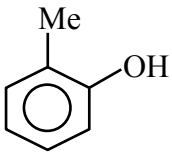
(B) I \rightarrow P ; II \rightarrow R, S; III \rightarrow R; IV \rightarrow Q, S

(C) I \rightarrow Q, S; II \rightarrow P, T; III \rightarrow P; IV \rightarrow S

(D) I \rightarrow P, S; II \rightarrow T; III \rightarrow Q, R; IV \rightarrow P

Ans. (D)

Sol.  : Blue colour in Lassign test due to presence of N
Aniline

 : Violet colour with FeCl_3 due to presence of phenolic OH
o-Cresol

$\text{HS-CH}_2\text{-CH(NH}_2\text{)-COOH}$
Cystein : It gives blod red colour with NaSCN

 : Blue colour in Lassign test due to presence of N
Caprolactam