

FINAL JEE(Advanced) EXAMINATION – 2023

(Held On Sunday 04th June, 2023)

PAPER-1

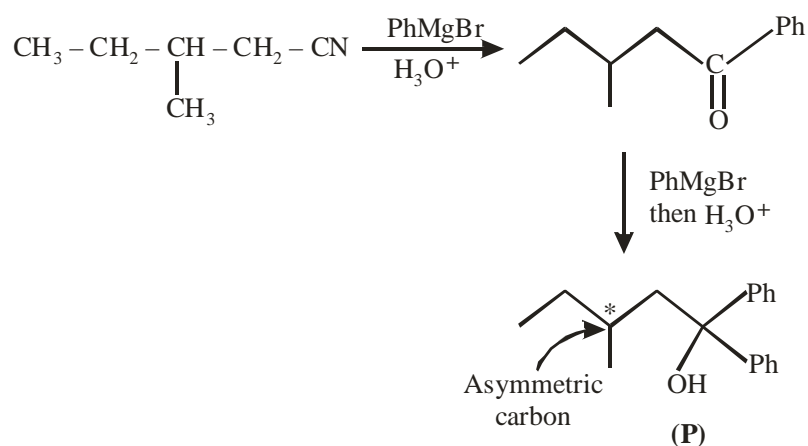
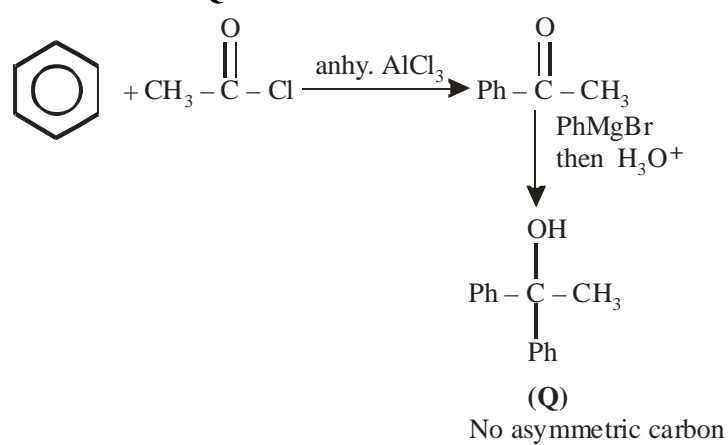
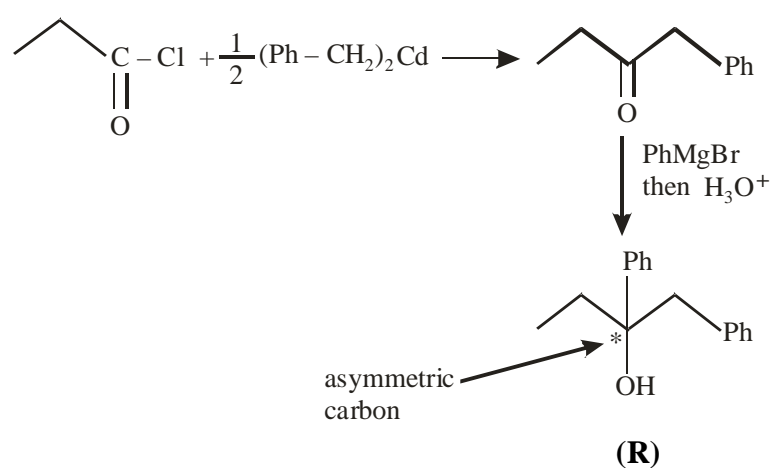
TEST PAPER WITH SOLUTION

CHEMISTRY**SECTION-1 : (Maximum Marks : 12)**

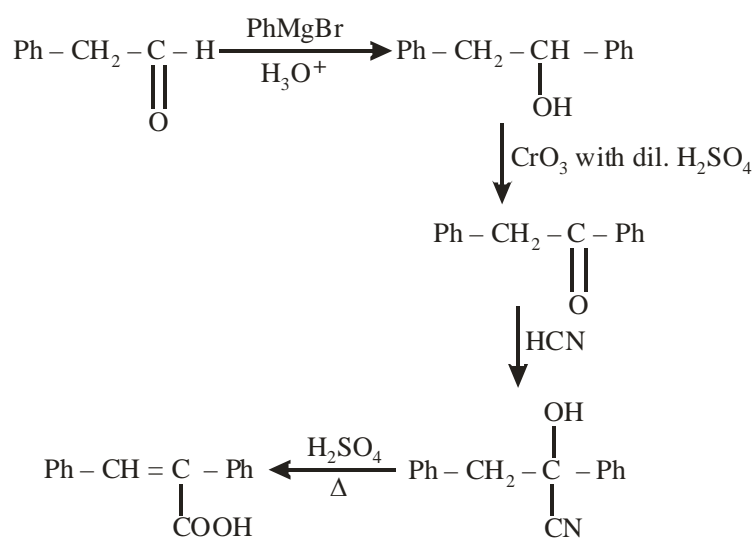
- This section contains **THREE (03)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will 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.
- For example, in a question, if (A), (B) and (D) are the **ONLY** three options corresponding to correct answers, then
 - choosing **ONLY** (A), (B) and (D) will get +4 marks;
 - choosing **ONLY** (A) and (B) will get +2 marks;
 - choosing **ONLY** (A) and (D) will get +2 marks;
 - choosing **ONLY** (B) and (D) will get +2 marks;
 - choosing **ONLY** (A) will get +1 marks;
 - choosing **ONLY** (B) will get +1 marks;
 - choosing **ONLY** (D) will get +1 marks;
 - choosing no option (i.e. the question is unanswered) will get 0 marks; and
 - choosing any other combination of options will get -2 marks.

1. The correct statement(s) related to processes involved in the extraction of metals is(are)
- (A) Roasting of Malachite produces Cuprite.
 - (B) Calcination of Calamine produces Zincite.
 - (C) Copper pyrites is heated with silica in a reverberatory furnace to remove iron.
 - (D) Impure silver is treated with aqueous KCN in the presence of oxygen followed by reduction with zinc metal.

Ans. (B,C,D)

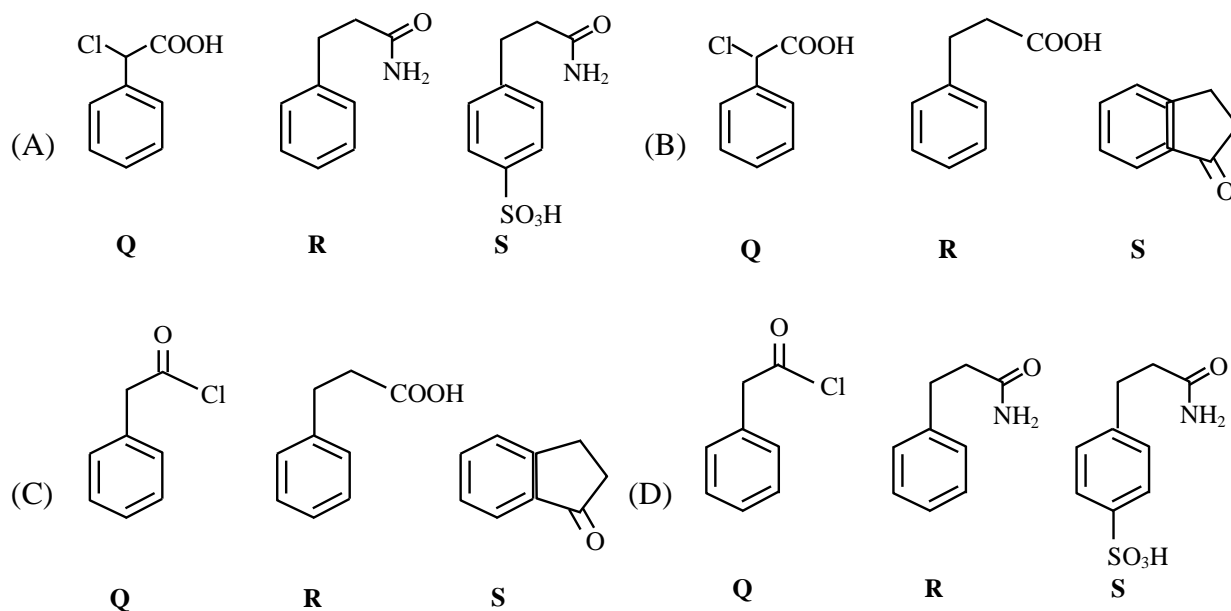
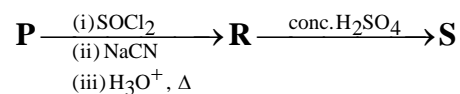
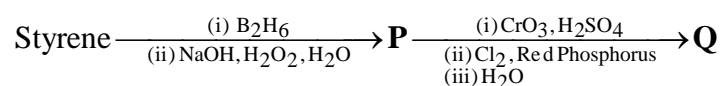
Sol. Formation of P**Formation of Q****Formation of R**

Formation of S



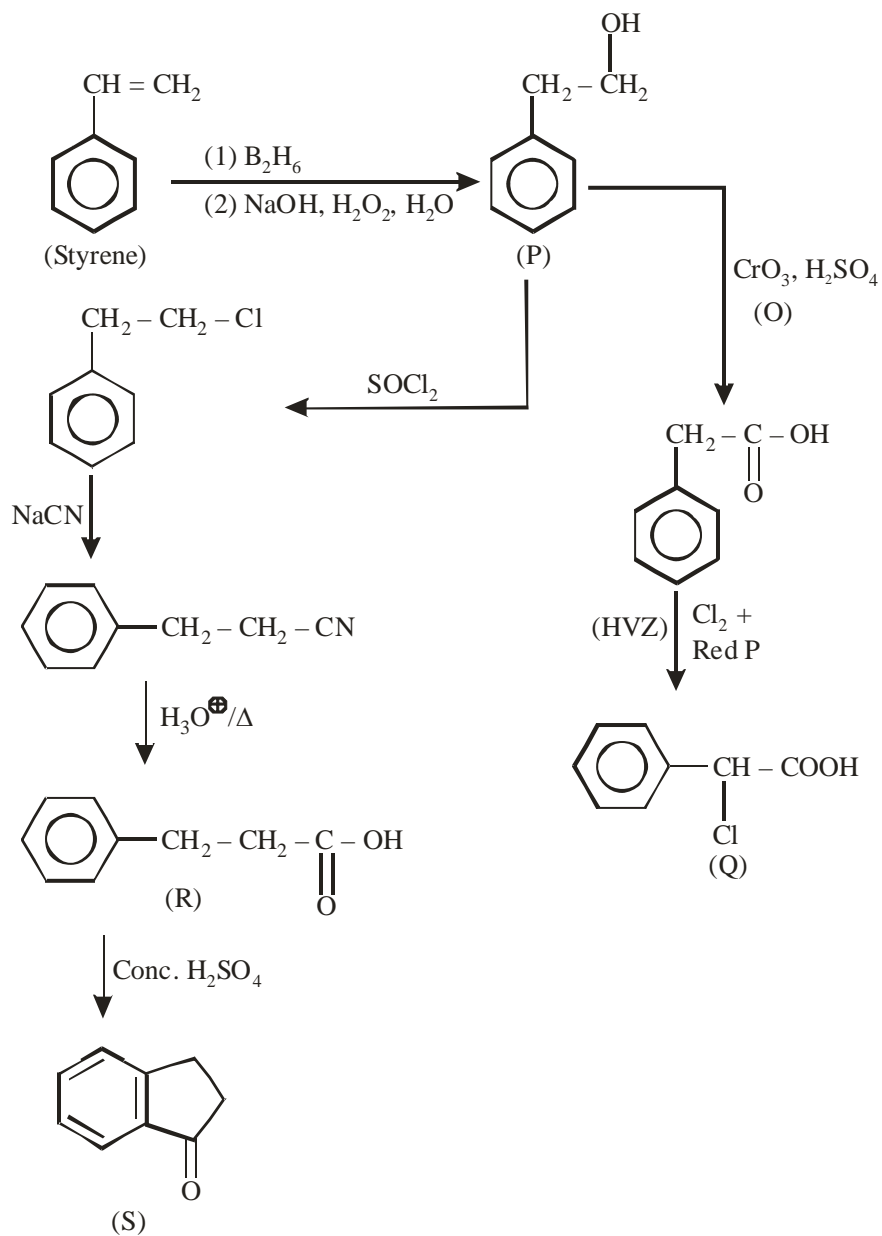
(S) No asymmetric carbon

3. Consider the following reaction scheme and choose the correct option(s) for the major products **Q**, **R** and **S**.



Ans. (B)

Sol.



Sol. For weak acid, $\alpha = \frac{\Lambda_m}{\Lambda_0}$

$$K_a = \frac{C\alpha^2}{1-\alpha} \Rightarrow K_a(1-\alpha) = C\alpha^2$$

$$\Rightarrow K_a \left(1 - \frac{\Lambda_m}{\Lambda_0}\right) = C \left(\frac{\Lambda_m}{\Lambda_0}\right)^2$$

$$\Rightarrow K_a - \frac{\Lambda_m K_a}{\Lambda_0} = \frac{C\Lambda_m^2}{(\Lambda_0)^2}$$

Divide by ' Λ_m '

$$\Rightarrow \frac{K_a}{\Lambda_m} = \frac{C\Lambda_m}{(\Lambda_0)^2} + \frac{K_a}{\Lambda_0}$$

$$\Rightarrow \frac{1}{\Lambda_m} = \frac{C\Lambda_m}{K_a(\Lambda_0)^2} + \frac{1}{\Lambda_0}$$

Plot $\frac{1}{\Lambda_m}$ vs $C\Lambda_m$ has

$$\text{Slope} = \frac{1}{K_a(\Lambda_0)^2} = S$$

$$\text{y-intercept} = \frac{1}{\Lambda_0} = P$$

$$\text{Then, } \frac{P}{S} = \frac{\frac{1}{\Lambda_0}}{\frac{1}{K_a(\Lambda_0)^2}} = K_a\Lambda_0$$

6. On decreasing the pH from 7 to 2, the solubility of a sparingly soluble salt (MX) of a weak acid (HX) increased from $10^{-4} \text{ mol L}^{-1}$ to $10^{-3} \text{ mol L}^{-1}$. The pK_a of HX is:

(A) 3

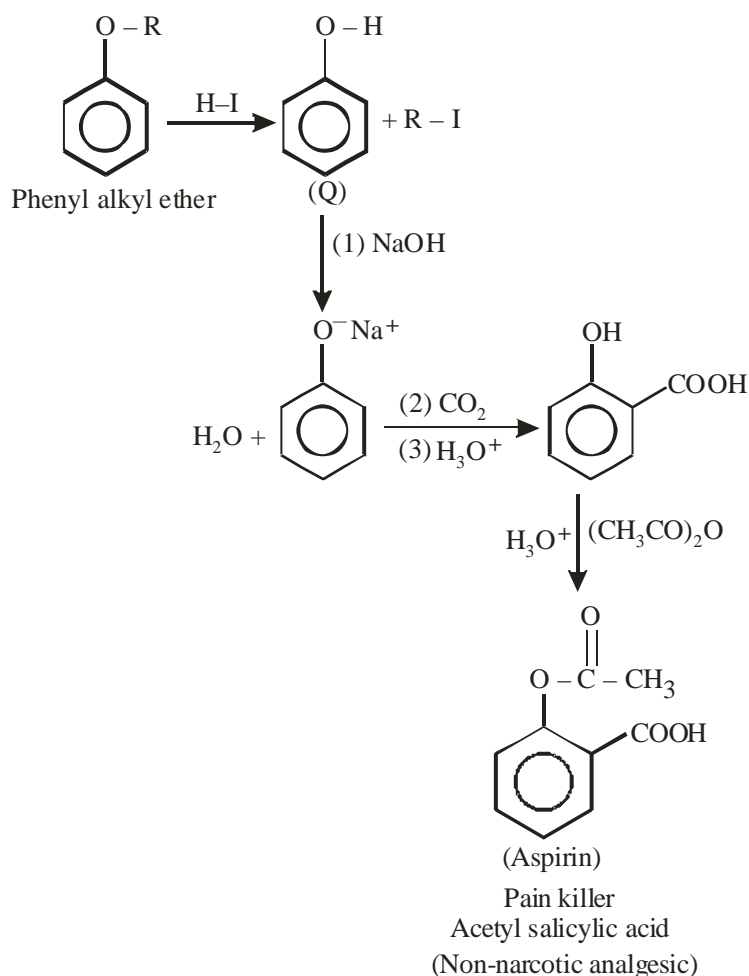
(B) 4

(C) 5

(D) 2

Ans. (B)

i.e.



Correct ans is (B)

Aspirin inhibits the synthesis of chemicals known as prostaglandin's.

SECTION-3 : (Maximum Marks : 24)

- This section contains **SIX (06)** questions.
- The answer to each question is a **NON-NEGATIVE INTEGER**.
- For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 **ONLY** If the correct integer is entered;
Zero Marks : 0 In all other cases.

8. The stoichiometric reaction of 516 g of dimethyldichlorosilane with water results in a tetrameric cyclic product **X** in 75% yield. The weight (in g) of **X** obtained is ____.
 [Use, molar mass (g mol⁻¹): H = 1, C = 12, O = 16, Si = 28, Cl = 35.5]

Ans. (222)

$$\Rightarrow \log k_b = \frac{-E_b}{2.303RT} + \log A_b$$

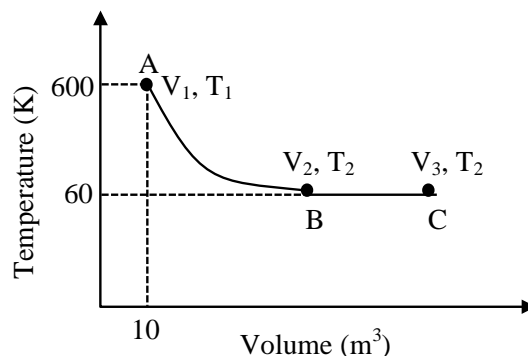
At 250 K

$$\Rightarrow \log k_b = -\frac{4000}{250} + \log(10^{11}) \quad [\text{From equation (1)}]$$

$$= -16 + 11 = -5$$

$$|\log k_b| = 5$$

11. One mole of an ideal monoatomic gas undergoes two reversible processes (A \rightarrow B and B \rightarrow C) as shown in the given figure :



A \rightarrow B is an adiabatic process. If the total heat absorbed in the entire process (A \rightarrow B and B \rightarrow C) is $RT_2 \ln 10$, the value of $2 \log V_3$ is _____.

[Use, molar heat capacity of the gas at constant pressure, $C_{p,m} = \frac{5}{2} R$]

Ans. (7)

Sol. For A \rightarrow B $600 V_1^{\gamma-1} = 60 V_2^{\gamma-1}$ ($\gamma = 5/3$)

(Reversible adiabatic)

$$\Rightarrow 600 (V_1)^{2/3} = 60 (V_2)^{2/3}$$

$$\Rightarrow 10 = \left(\frac{V_2}{V_1} \right)^{2/3}$$

$$\Rightarrow 10 = \left(\frac{V_2}{10} \right)^{2/3}$$

$$\Rightarrow V_2 = 10(10)^{3/2} = 10^{5/2}$$

Now, $q_{\text{net}} = RT_2 \ln 10 = 60 R \ln 10 = q_{\text{AB}} + q_{\text{BC}}$

$$\therefore q_{\text{AB}} = 0$$

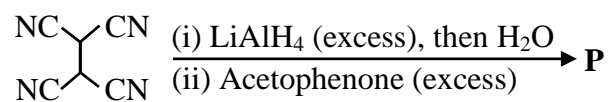
$$\Rightarrow q_{\text{BC}} = 60 R \ln 10 = 60 R \ln \frac{V_3}{V_2} \quad [\because \text{B} \rightarrow \text{C} \text{ is reversible isothermal}]$$

$$\Rightarrow 60 R \ln 10 = 60 R \ln \left(\frac{V_3}{10^{5/2}} \right)$$

$$\Rightarrow \log 10 = \log V_3 - \frac{5}{2}$$

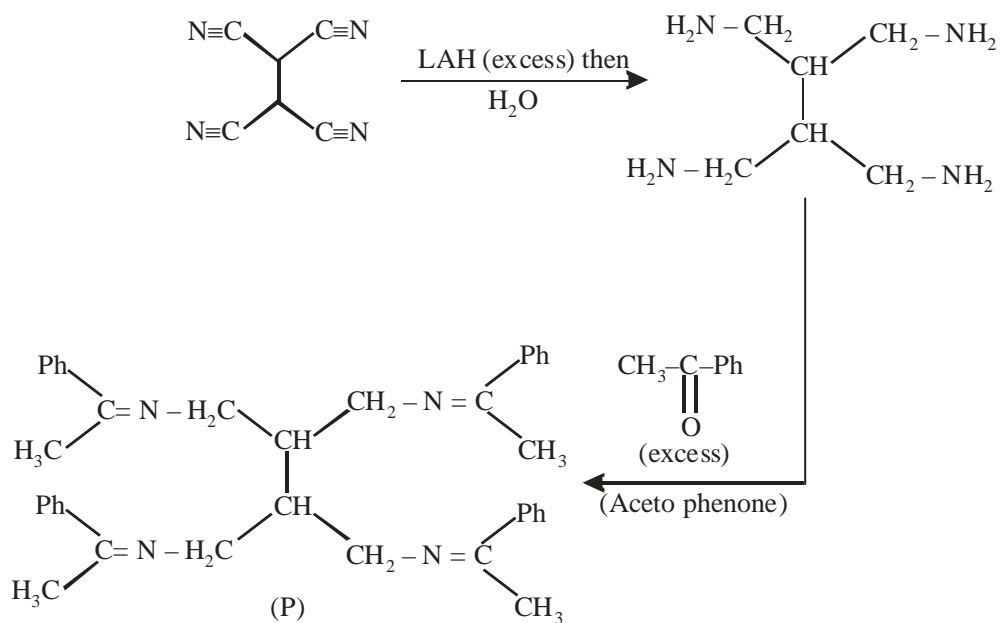
$$\Rightarrow \log V_3 = \frac{7}{2} \Rightarrow 2 \log V_3 = 7$$

13. The total number of sp^2 hybridised carbon atoms in the major product **P** (a non-heterocyclic compound) of the following reaction is _____.



Ans. (28)

Sol.



Total number of sp^2 hybridised C-atom in P = 28

SECTION-4 : (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 (P), (Q), (R) and (S) and **List-II** has **Five** entries (1), (2), (3), (4) and (5).
- **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.

14. Match the reactions (in the given stoichiometry of the reactants) in List-I with one of their products given in List-II and choose the correct option.

List-I

- (P) $\text{P}_2\text{O}_3 + 3\text{H}_2\text{O} \rightarrow$
 (Q) $\text{P}_4 + 3\text{NaOH} + 3\text{H}_2\text{O} \rightarrow$
 (R) $\text{PCl}_5 + \text{CH}_3\text{COOH} \rightarrow$
 (S) $\text{H}_3\text{PO}_2 + 2\text{H}_2\text{O} + 4\text{AgNO}_3 \rightarrow$

List-II

- (1) $\text{P}(\text{O})(\text{OCH}_3)\text{Cl}_2$
 (2) H_3PO_3
 (3) PH_3
 (4) POCl_3
 (5) H_3PO_4

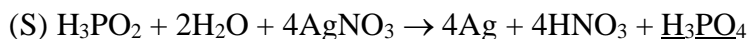
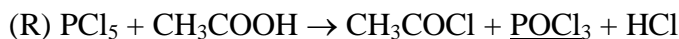
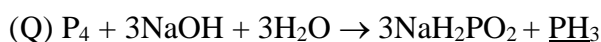
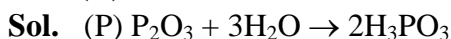
(A) $\text{P} \rightarrow 2; \text{Q} \rightarrow 3; \text{R} \rightarrow 1; \text{S} \rightarrow 5$

(B) $\text{P} \rightarrow 3; \text{Q} \rightarrow 5; \text{R} \rightarrow 4; \text{S} \rightarrow 2$

(C) $\text{P} \rightarrow 5; \text{Q} \rightarrow 2; \text{R} \rightarrow 1; \text{S} \rightarrow 3$

(D) $\text{P} \rightarrow 2; \text{Q} \rightarrow 3; \text{R} \rightarrow 4; \text{S} \rightarrow 5$

Ans. (D)



15. Match the electronic configurations in List-I with appropriate metal complex ions in List-II and choose the correct option.

[Atomic Number: Fe = 26, Mn = 25, Co = 27]

List-I

- (P) $t_{2g}^6 e_g^0$
 (Q) $t_{2g}^3 e_g^2$
 (R) $e^2 t_2^3$
 (S) $t_{2g}^4 e_g^2$

List-II

- (1) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
 (2) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$
 (3) $[\text{Co}(\text{NH}_3)_6]^{3+}$
 (4) $[\text{FeCl}_4]^-$
 (5) $[\text{CoCl}_4]^{2-}$

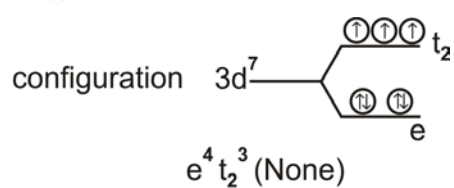
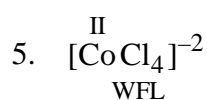
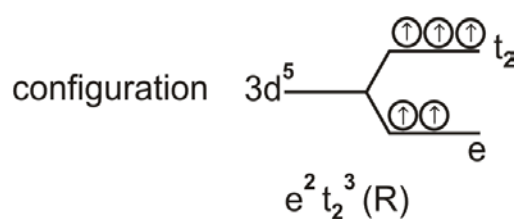
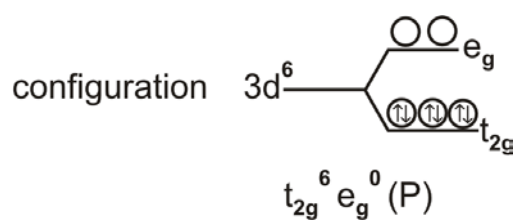
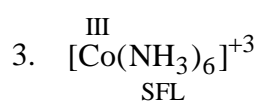
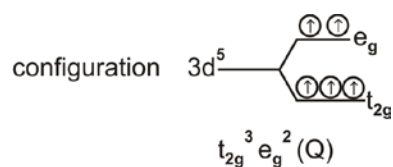
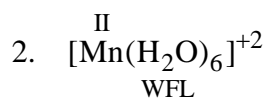
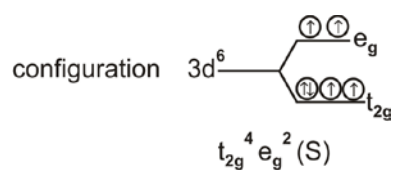
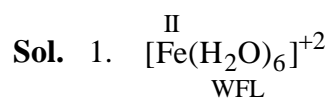
(A) $\text{P} \rightarrow 1; \text{Q} \rightarrow 4; \text{R} \rightarrow 2; \text{S} \rightarrow 3$

(B) $\text{P} \rightarrow 1; \text{Q} \rightarrow 2; \text{R} \rightarrow 4; \text{S} \rightarrow 5$

(C) $\text{P} \rightarrow 3; \text{Q} \rightarrow 2; \text{R} \rightarrow 5; \text{S} \rightarrow 1$

(D) $\text{P} \rightarrow 3; \text{Q} \rightarrow 2; \text{R} \rightarrow 4; \text{S} \rightarrow 1$

Ans. (D)



17. The major products obtained from the reactions in List-II are the reactants for the named reactions mentioned in List-I. Match List-I with List-II and choose the correct option.

List-I	List-II
(P) Etard reaction	(1) Acetophenone $\xrightarrow{\text{Zn-Hg, HCl}}$
(Q) Gattermann reaction	(2) Toluene $\xrightarrow[\text{(ii) SOCl}_2]{\text{(i) KMnO}_4, \text{KOH}, \Delta}$
(R) Gattermann-Koch reaction	(3) Benzene $\xrightarrow[\text{anhyd. AlCl}_3]{\text{CH}_3\text{Cl}}$
(S) Rosenmund reduction	(4) Aniline $\xrightarrow[273-278 \text{ K}]{\text{NaNO}_2/\text{HCl}}$
	(5) Phenol $\xrightarrow{\text{Zn}, \Delta}$

- (A) P \rightarrow 2; Q \rightarrow 4; R \rightarrow 1; S \rightarrow 3
 (B) P \rightarrow 1; Q \rightarrow 3; R \rightarrow 5; S \rightarrow 2
 (C) P \rightarrow 3; Q \rightarrow 2; R \rightarrow 1; S \rightarrow 4
 (D) P \rightarrow 3; Q \rightarrow 4; R \rightarrow 5; S \rightarrow 2

Ans. (D)

Sol. P \rightarrow 3, Q \rightarrow 4, R \rightarrow 5, S \rightarrow 2

