

**JEE Adv. June 2023**  
**Question Paper With Text Solution**  
**04 June | Paper-1**

**CHEMISTRY**



**JEE Main & Advanced | XI-XII Foundation | VI-X Pre-Foundation**

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**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;

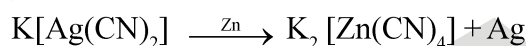
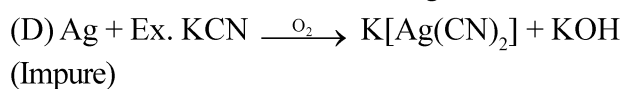
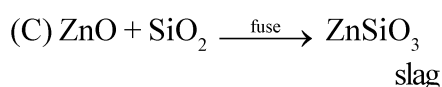
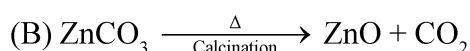
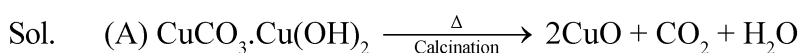
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);

Negative Marks : -2 In all other cases.

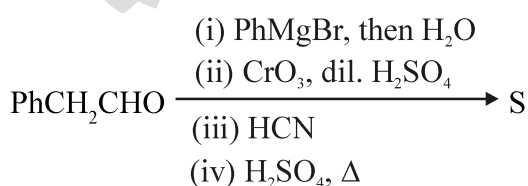
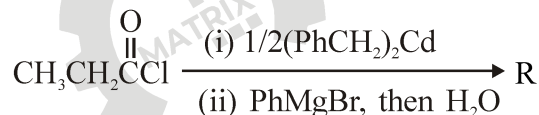
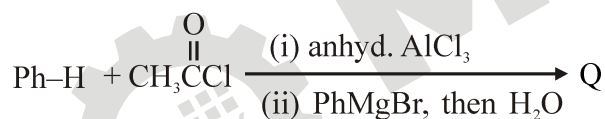
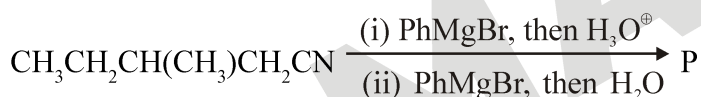
- For example, in a question, if (A), (B) and (D) are the **ONLY** three options corresponding to correct answers, then  
choosing **ONLY** (A), (B) and (D) will get +4 marks;  
choosing **ONLY** (A) and (B) will get +2 marks;  
choosing **ONLY** (A) and (D) will get +2 marks;  
choosing **ONLY** (B) and (D) will get +2 marks;  
choosing **ONLY** (A) will get +1 mark;  
choosing **ONLY** (B) will get +1 mark;  
choosing **ONLY** (D) will get +1 mark;  
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. BCD



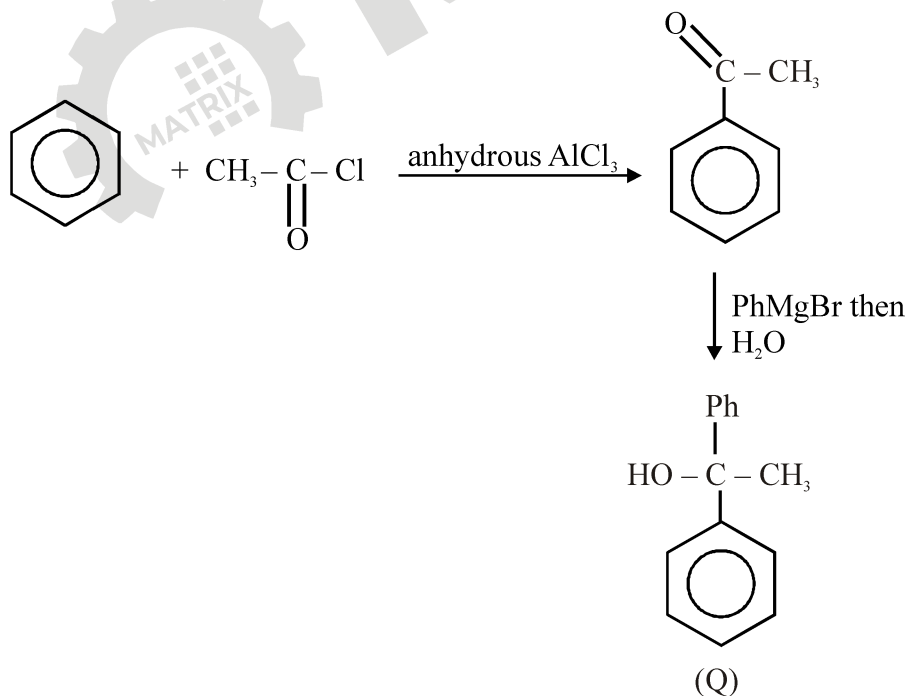
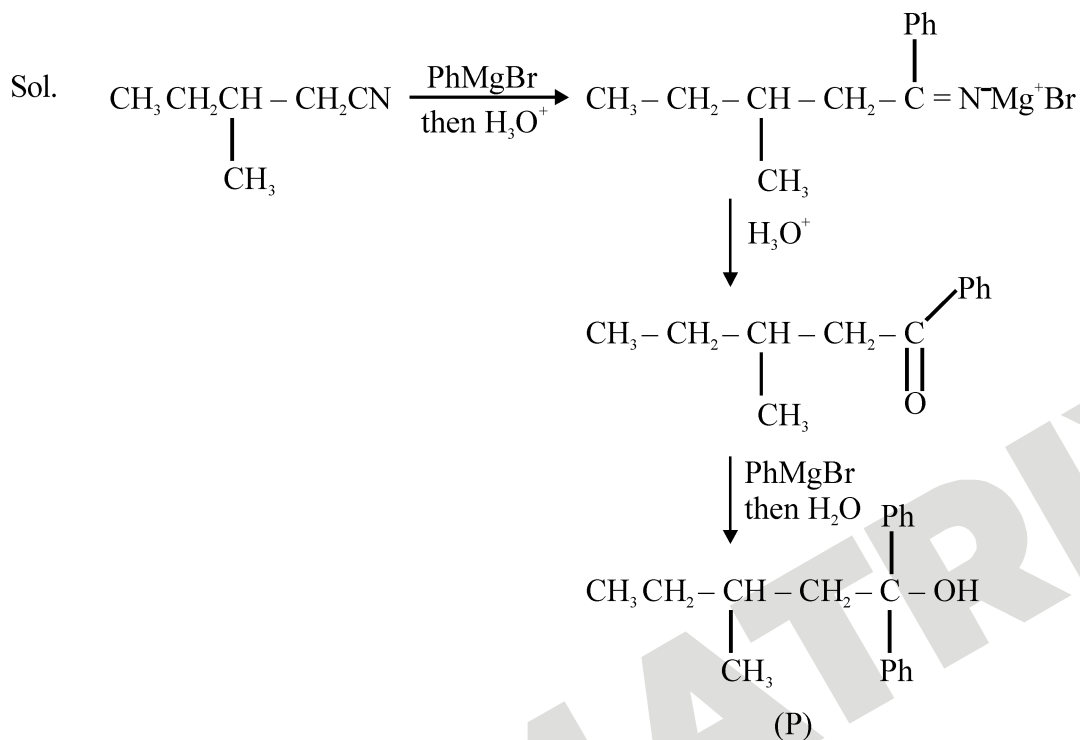
2. In the following reactions, P, Q, R, and S are the major products.

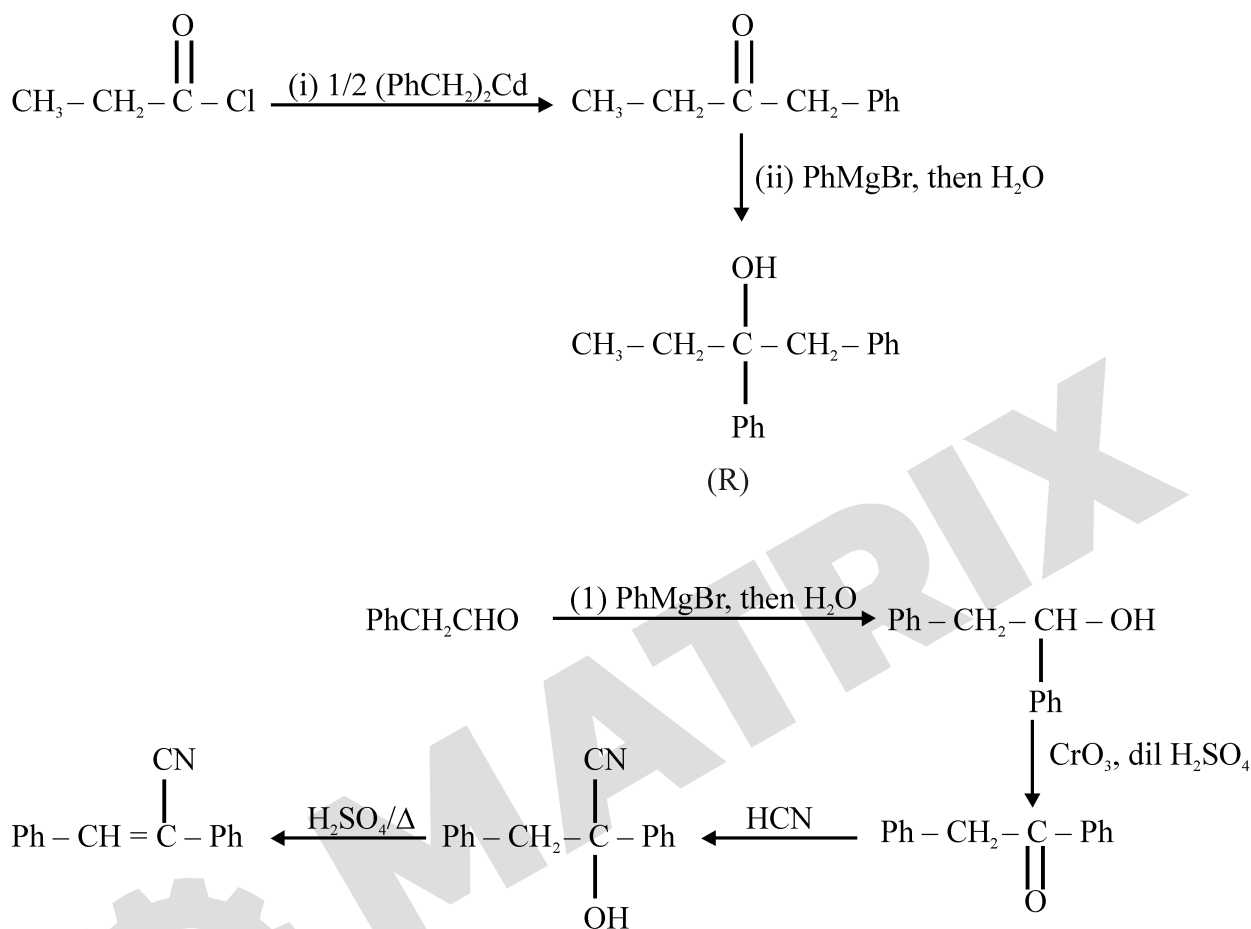


The correct statement(s) about P, Q, R, and S is(are)

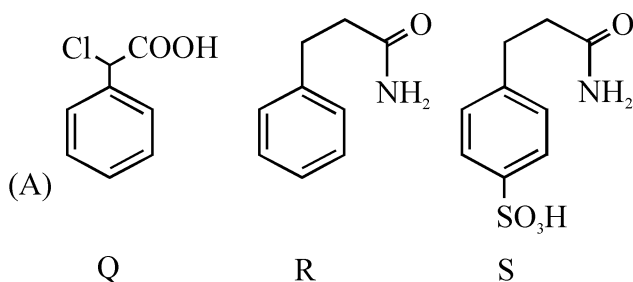
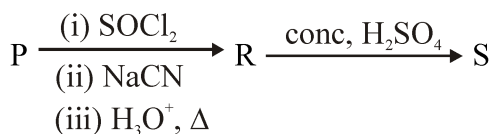
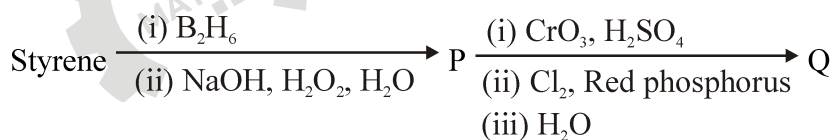
- (A) Both P and Q have asymmetric carbon(s).  
 (B) Both Q and R have asymmetric carbon(s).  
 (C) Both P and R have asymmetric carbon(s).  
 (D) P has asymmetric carbon(s), S does not have any asymmetric carbon.

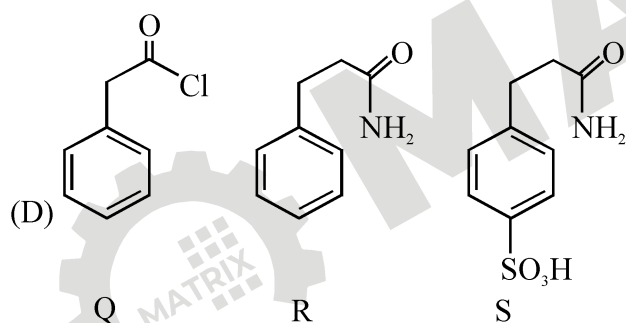
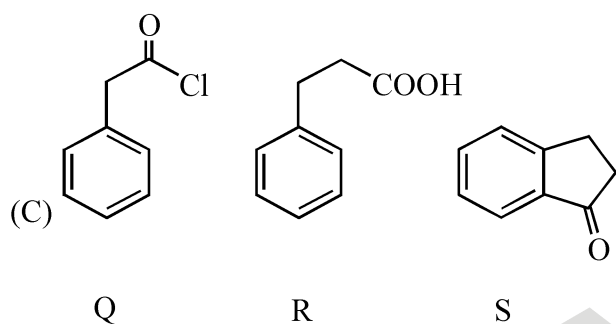
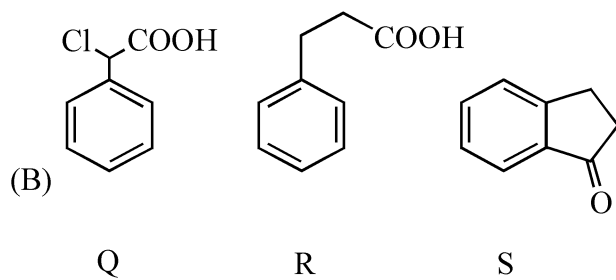
Ans. CD



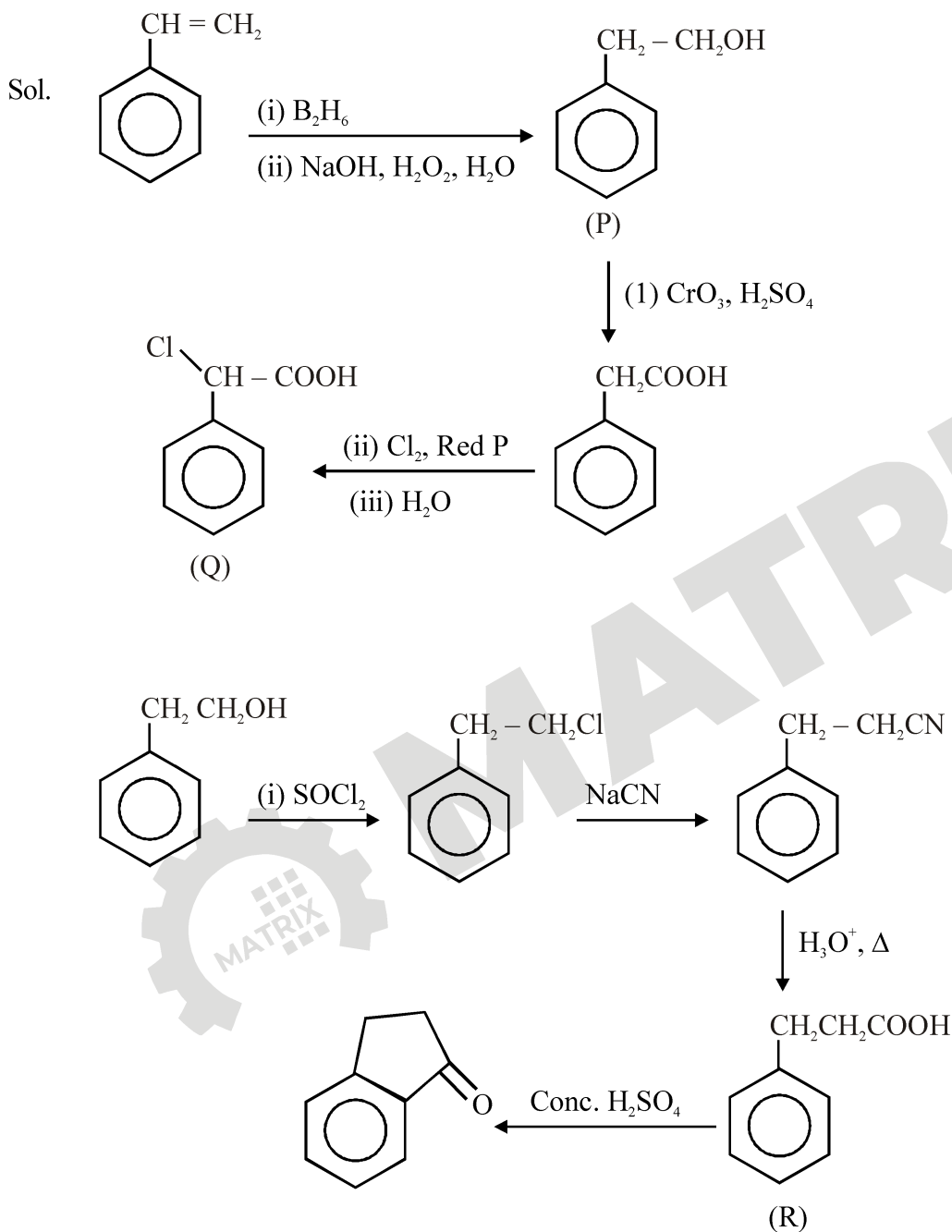


3. Consider the following reaction scheme and choose the correct option(s) for the major products Q, R and S.





Ans. B









- (A)  $K_a \Lambda_m^\circ$       (B)  $K_a \Lambda_m^\circ / 2$       (C)  $2K_a \Lambda_m^\circ$       (D)  $1 / (K_a \Lambda_m^\circ)$

Ans. A

Sol.  $\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$

$$k_a = \frac{c\alpha^2}{1-\alpha}$$

$$k_a = \frac{c\Lambda_m^2}{(\Lambda_m^\circ)^2 - \left(1 - \frac{\Lambda_m}{\Lambda_m^\circ}\right)}$$

$$k_a = \frac{c\Lambda_m^2}{\Lambda_m^\circ (\Lambda_m^\circ - \Lambda_m)}$$

$$k_a = \frac{c\Lambda_m^2}{\Lambda_m^{\circ 2} - \Lambda_m^\circ \Lambda_m}$$

$$k_a (\Lambda_m^{\circ 2} - k_a \Lambda_m^\circ \Lambda_m) = c\Lambda_m^2$$

$$k_a \Lambda_m^{\circ 2} \cdot \frac{1}{\Lambda_m^\circ} - k_a \Lambda_m^\circ = c\Lambda_m$$

$$k_a \Lambda_m^{\circ 2} \cdot \frac{1}{\Lambda_m^\circ} = c\Lambda_m + k_a \Lambda_m^\circ$$

$$\frac{1}{\Lambda_m^\circ} = \frac{1}{k_a \Lambda_m^{\circ 2}} c\Lambda_m + \frac{1}{\Lambda_m^\circ}$$

$$P = \frac{1}{\Lambda_m^\circ}$$

$$S = \frac{1}{k_a \Lambda_m^{\circ 2}}$$

$$\frac{P}{S} = \frac{1}{\Lambda_m^\circ} \times k_a \Lambda_m^{\circ 2} = k_a \Lambda_m^\circ$$

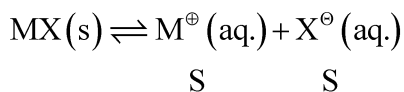
6. On decreasing the pH from 7 to 2, the solubility of a sparingly soluble salt (MX) of a weak acid (HX) increased from  $10^{-4} \text{ mol L}^{-1}$  to  $10^{-3} \text{ mol L}^{-1}$ . The  $pK_a$  of HX is

- (A) 3      (B) 4      (C) 5      (D) 2

Ans. B

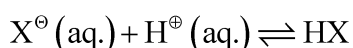
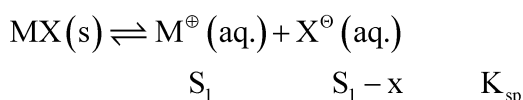


Sol. At pH = 7



$$K_{sp} = S^2 (10^{-4})^2 = 10^{-8}$$

at pH = 2



$$\underset{S_1 - x}{\text{X}^{\ominus}} + \underset{10^{-2}}{\text{H}^{\oplus}} \rightleftharpoons \underset{x}{\text{HX}} \quad \frac{1}{k_a}$$

$$K_{sp} = S_1(S_1 - x)$$

$$\frac{1}{k_a} = \frac{x}{(S_1 - x)10^{-2}}$$

$$\frac{k_{sp}}{k_a} = \frac{S_1 x}{10^{-2}}$$

$$S_1 - x \rightarrow 0 \Rightarrow S_1 \rightarrow x$$

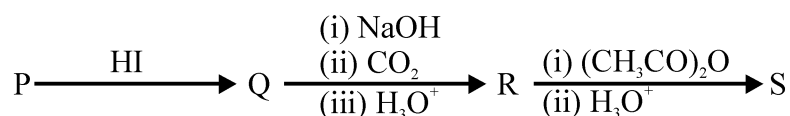
$$\frac{10^{-8}}{k_a} = \frac{S_1^2}{10^{-2}}$$

$$\frac{10^{-8}}{k_a} = \frac{10^{-6}}{10^{-2}}$$

$$k_a = 10^{-4}$$

$$p^{ka} = 4$$

7. In the given reaction scheme, P is a phenyl alkyl ether, Q is an aromatic compound; R and S are the major products.



The correct statement about S is

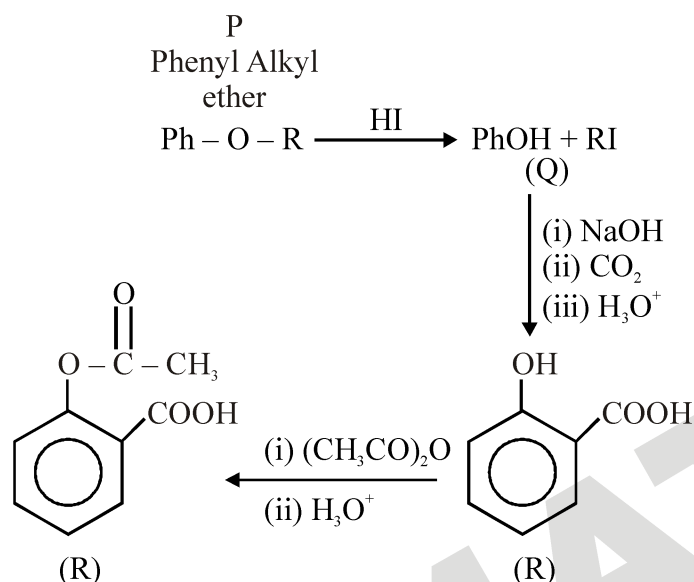
- (A) It primarily inhibits noradrenaline degrading enzymes.  
 (B) It inhibits the synthesis of prostaglandin.

(C) It is a narcotic drug.

(D) It is *ortho*-acetylbenzoic acid.

Ans. B

Sol.



### 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 onscreen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:

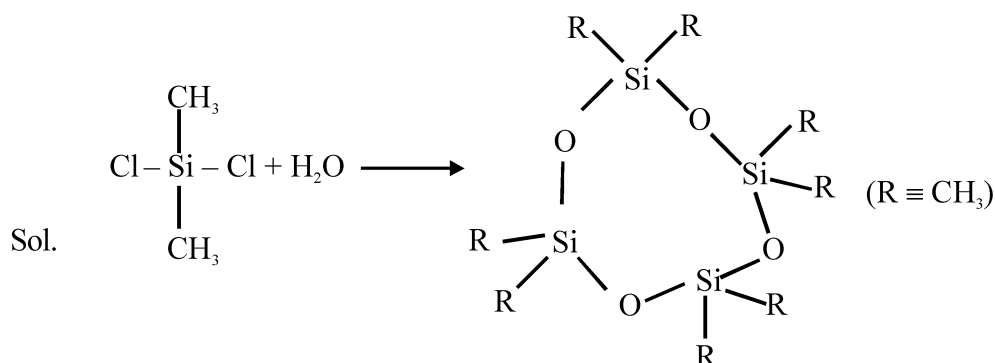
Full Marks : +4 If **ONLY** the correct integer is entered;

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<sup>-1</sup>): H = 1, C = 12, O = 16, Si = 28, Cl = 35.5]

Ans. 222



4 mole of dimethyl dichlorosilane will produce 1 mole of tetrameric cyclic product.

$$\text{mole of dimethylchlorosilane} = \frac{516}{129} = 4$$

$$\text{Mass of cyclic tetrameric product obtained} = \frac{1}{4} \times 0.75 \times 296 \times 4 = 222 \text{ gm}$$

9. A gas has a compressibility factor of 0.5 and a molar volume of  $0.4 \text{ dm}^3 \text{ mol}^{-1}$  at a temperature of 800 K and pressure  $x \text{ atm}$ . If it shows ideal gas behaviour at the same temperature and pressure, the molar volume will be  $y \text{ dm}^3 \text{ mol}^{-1}$ . The value of  $x/y$  is \_\_\_\_.

[Use: Gas constant,  $R = 8 \times 10^{-2} \text{ L atm K}^{-1} \text{ mol}^{-1}$ ]

Ans. 100

Sol.  $Z = 0.5$

$$V_m = 0.4 \text{ dm}^3 \text{ mole}^{-1}$$

$$T = 800 \text{ K}$$

$$P = x \text{ atm}$$

$$x \times 0.4 = 0.5 R \times 800 \Rightarrow x = \frac{5}{4} \times 8 \times 10^{-2} \times 800 = 800$$

$$x \times V_m = 1 \times R \times 800$$

$$\frac{0.4}{V_m} = 0.5$$

$$V_m = \frac{4}{5}$$

$$\text{Hence } y = \frac{4}{5}$$

$$\frac{x}{y} = \frac{80 \times 5}{4} = 100$$

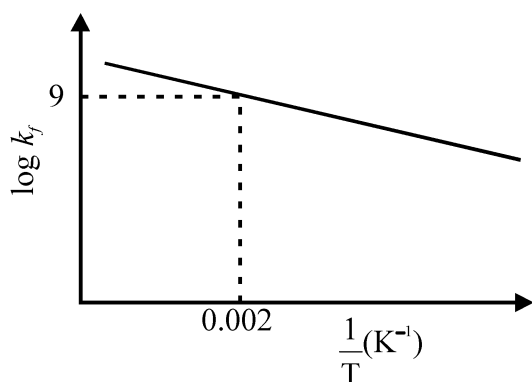
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10. The plot of  $\log k_f$  versus  $1/T$  for a reversible reaction  $A(g) \rightleftharpoons P(g)$  is shown.



Pre-exponential factors for the forward and backward reactions are  $10^{15} \text{ s}^{-1}$  and  $10^{11} \text{ s}^{-1}$ , respectively. If the value of  $\log K$  for the reaction at 500 K is 6, the value of  $|\log k_b|$  at 250 K is \_\_\_\_.

[K = equilibrium constant of the reaction

$k_f$  = rate constant of forward reaction

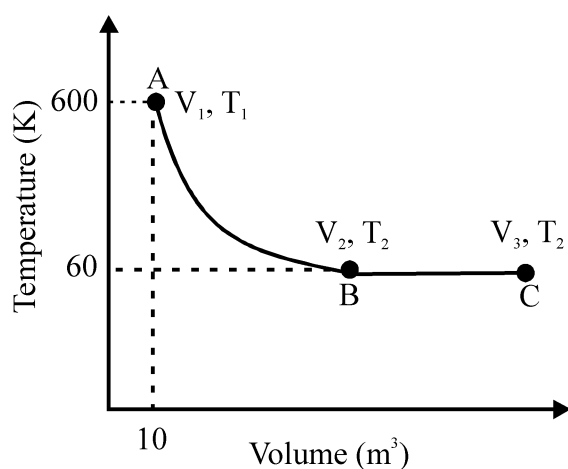
$k_b$  = rate constant of backward reaction]

Ans. 5

Sol.  $k_f = A_f e^{\frac{-E_{af}}{RT}}$

$$\log k_f = \log A_f - \frac{E_{af}}{R} \frac{1}{T}$$

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:



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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,  $C_{p,m} = 5/2 R$ ]

Ans. 7

Sol. Total heat absorbed in entire process = heat absorbed in BC process

$$q_{BC} = -w_{BC}$$

$$w_{BC} = -nRT \ln \frac{V_3}{V_2}$$

$$= -R \times 60 \ln \frac{V_3}{V_2}$$

In process AB

$$T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$$

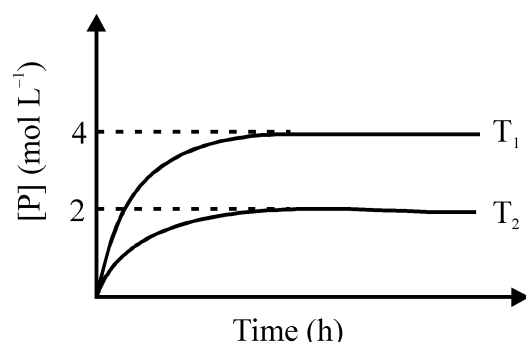
$$\frac{600}{60} = \left( \frac{V_2}{V_1} \right)^{\gamma-1}$$

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

$$q_{BC} = R \times 60 \ln \frac{V_3}{10(10)^{3/2}}$$

$$RT_2 = RT_2 \ln \frac{V_3}{10(10)^{3/2}}$$

12. In a one-litre flask, 6 moles of A undergoes the reaction  $A(g) \rightleftharpoons P(g)$ . The progress of product formation at two temperatures (in Kelvin),  $T_1$  and  $T_2$ , is shown in the figure:

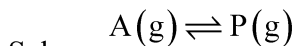


If  $T_1 = 2T_2$  and  $(\Delta G_2^\ominus - \Delta G_1^\ominus) = RT_2 \ln x$ , then the value of  $x$  is \_\_\_\_.



[ $\Delta G_1^\circ$  and  $\Delta G_2^\circ$  are standard Gibb's free energy change for the reaction at temperatures  $T_1$  and  $T_2$ , respectively.]

Ans. 8



6

at temperature  $T_2$   $k_p = \frac{2}{4} = \frac{1}{2}$

at temperature  $T_1$   $k_p = \frac{4}{2} = 2$

$$\Delta G_2^\circ = -RT_2 \ln \frac{1}{2}$$

$$\Delta G_1^\circ = -RT_1 \ln 2$$

$$\Delta G_2^\circ - \Delta G_1^\circ = -RT_2 \ln \frac{1}{2} + RT_1 \ln 2$$

$$= RT_2 \ln 2 + R(2T_2) \ln 2$$

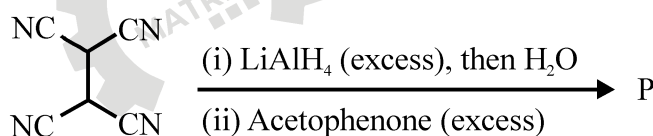
$$= (RT_2 + 2RT_2) \ln 2$$

$$= RT_2 \ln(2)^3$$

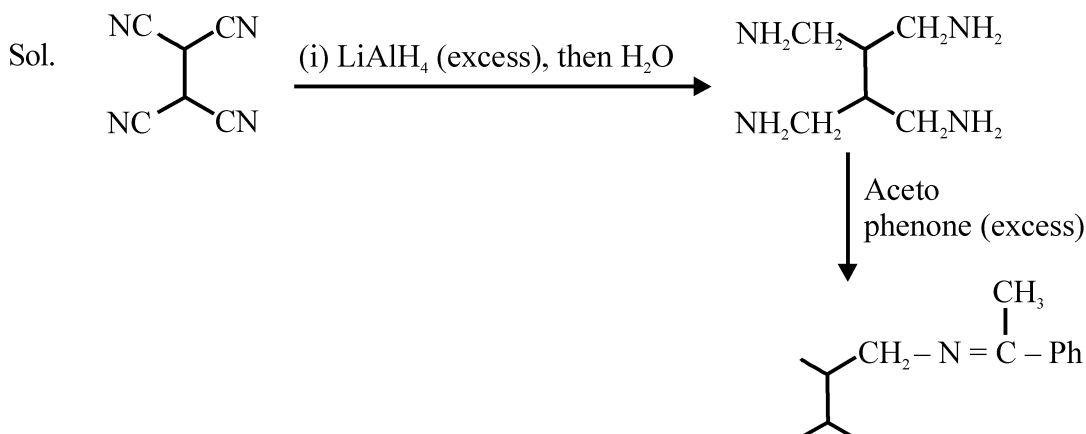
$$= RT_2 \ln 8$$

$$x = 8$$

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



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**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:

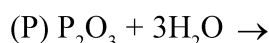
Full Marks : **+3 ONLY** if the option corresponding to the correct combination is chosen;

Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);

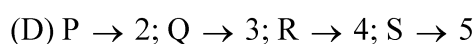
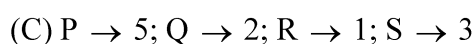
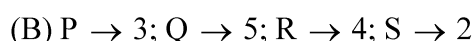
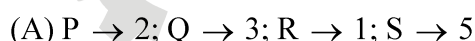
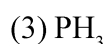
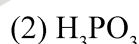
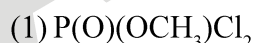
Negative Marks : -1 In all other cases.

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.

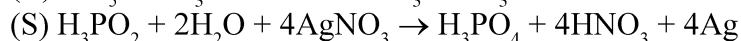
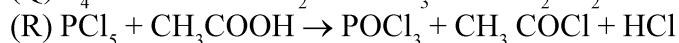
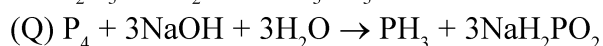
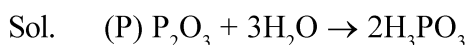
List-I



List-II



Ans. D

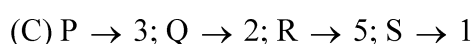
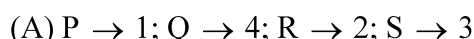
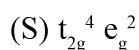
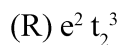
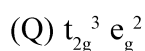
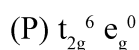


15. Match the electronic configurations in List-I with appropriate metal complex ions in List-II and choose the correct option.

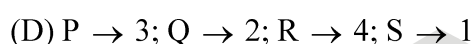
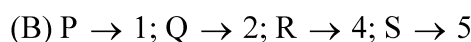
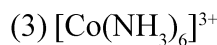
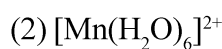
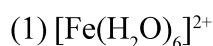
[Atomic Number: Fe = 26, Mn = 25, Co = 27]



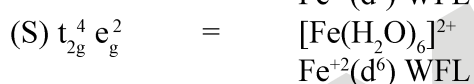
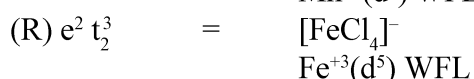
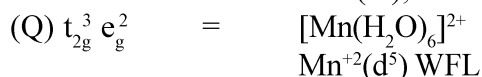
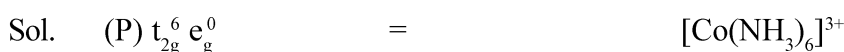
List-I



List-II

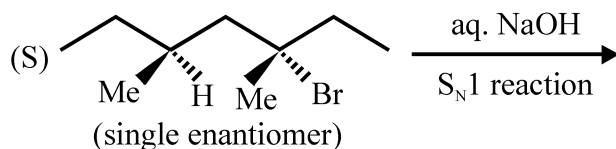
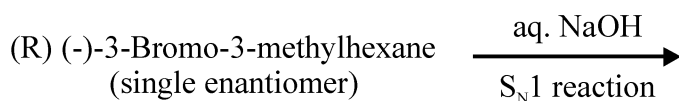


Ans. D



16. Match the reactions in List-I with the features of their products in List-II and choose the correct option.

List-I



List-II

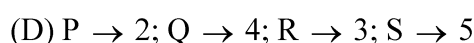
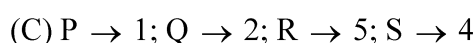
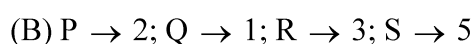
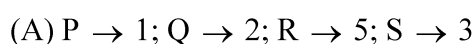
(1) Inversion of configuration

(2) Retention of configuration

(3) Mixture of enantiomers

(4) Mixture of structural isomers

(5) Mixture of diastereomers

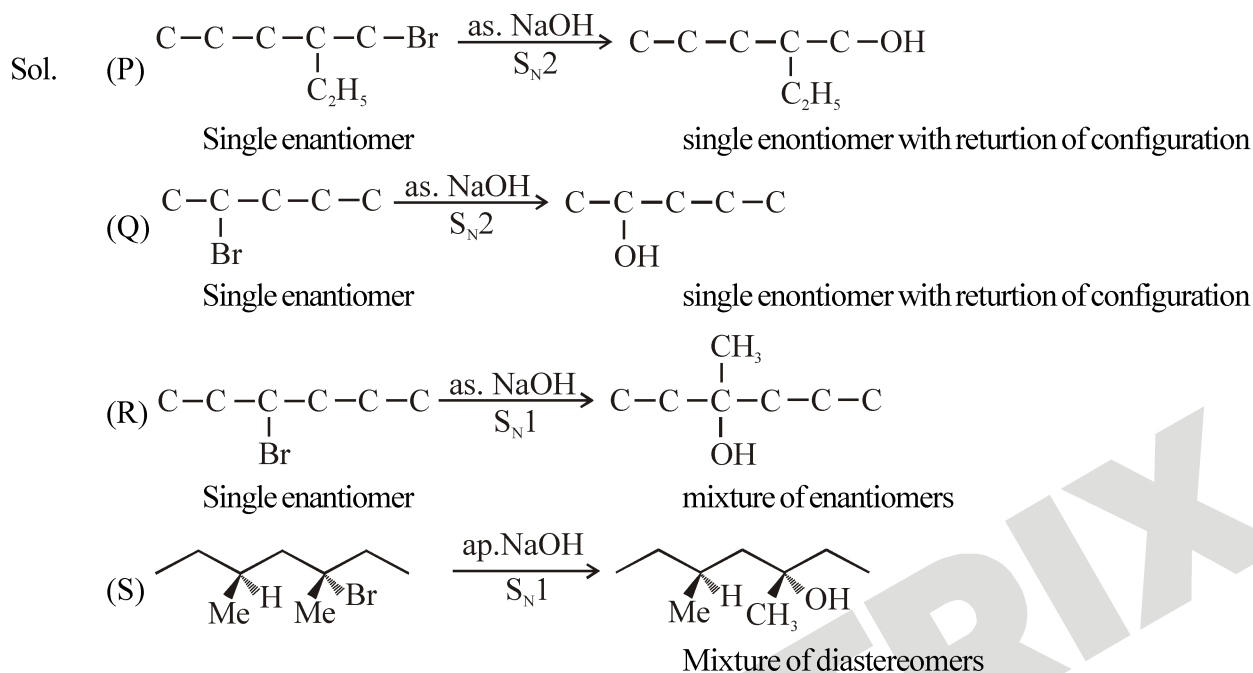


Ans. B

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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

(P) Etard reaction

(Q) Gattermann reaction

(R) Gattermann-Koch reaction

(S) Rosenmund reduction

List-II

 (1) Acetophenone  $\xrightarrow{\text{Zn-Hg, HCl}}$ 

 (2) Toluene  $\xrightarrow[\text{(ii) SOCl}_2]{\text{(i) KMnO}_4, \text{KOH}, \Delta}$ 

 (3) Benzene  $\xrightarrow[\text{anhyd. AlCl}_3]{\text{CH}_3\text{Cl}}$ 

 (4) Aniline  $\xrightarrow[273-278 \text{ K}]{\text{NaNO}_2/\text{HCl}}$ 

 (5) Phenol  $\xrightarrow{\text{Zn}, \Delta}$ 

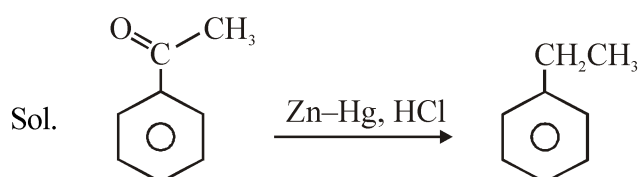
 (A) P  $\rightarrow$  2; Q  $\rightarrow$  4; R  $\rightarrow$  1; S  $\rightarrow$  3

 (C) P  $\rightarrow$  3; Q  $\rightarrow$  2; R  $\rightarrow$  1; S  $\rightarrow$  4

 (B) P  $\rightarrow$  1; Q  $\rightarrow$  3; R  $\rightarrow$  5; S  $\rightarrow$  2

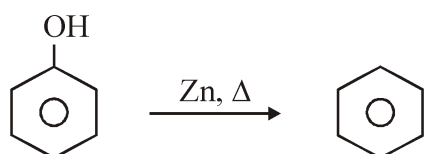
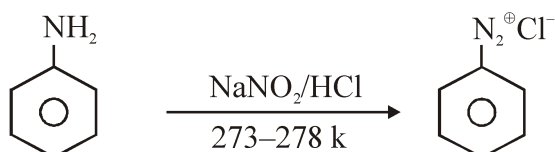
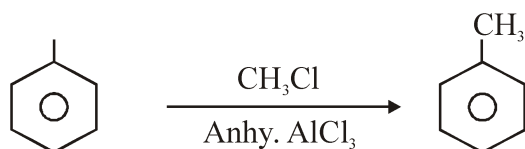
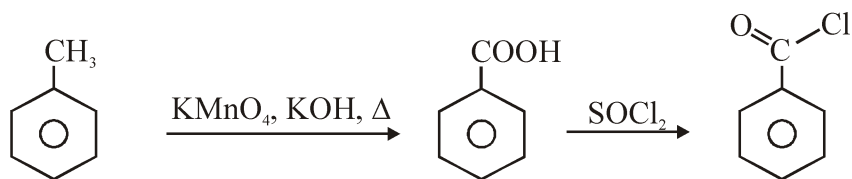
 (D) P  $\rightarrow$  3; Q  $\rightarrow$  4; R  $\rightarrow$  5; S  $\rightarrow$  2

Ans. D

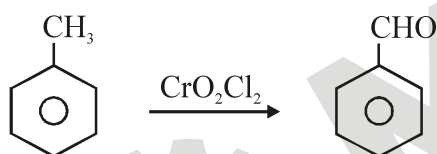

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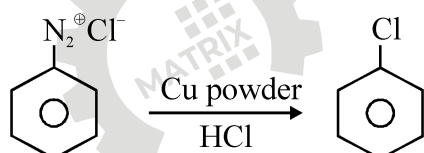
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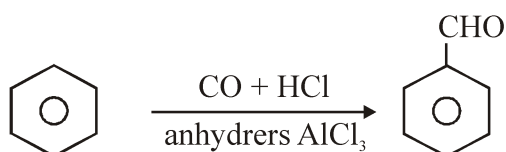
Etard Reaction



Gatterman reaction



Gatterman koch reaction



Rosenmund

