

JEE ADVANCED-2018

CHEMISTRY

General Instructions:

SECTION I

(Maximum Marks: 24)

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

Full Marks : +4 If only (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 options.

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).

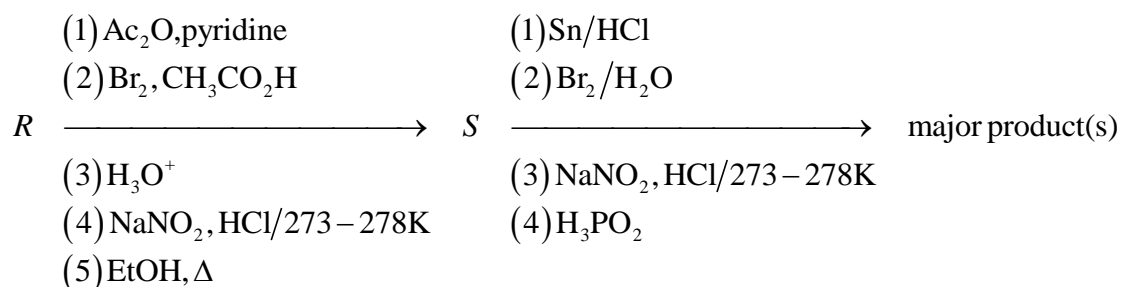
Negative Marks: -2 In all other cases.

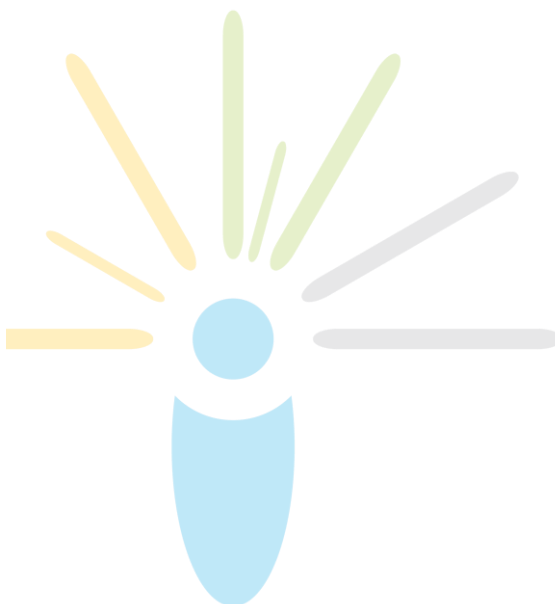
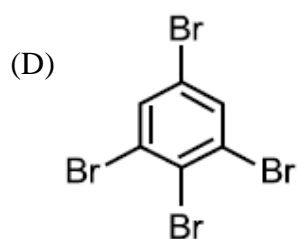
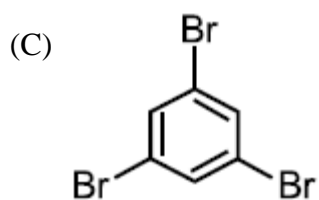
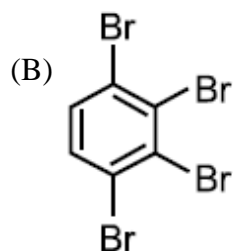
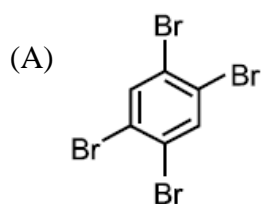
- **For Example:** If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

1. The correct option(s) regarding the complex $[\text{Co}(\text{en})(\text{NH}_3)_3(\text{H}_2\text{O})]^{3+}$ ($\text{en}=\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$) is (are)
- (A) It has two geometrical isomers
- (B) It will have three geometrical isomers if bidentate 'en' is replaced by two cyanide ligands
- (C) It is paramagnetic
- (D) It absorbs light at longer wavelength as compared to $[\text{Co}(\text{en})(\text{NH}_3)_4]^{3+}$

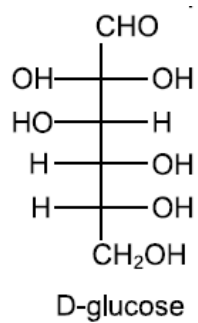
2. The correct option(s) to distinguish nitrate salts of Mn^{2+} and Cu^{2+} taken separately is (are)
- (A) Mn^{2+} show the characteristic green colour in the flame test
- (B) Only Cu^{2+} show the formation of precipitate by passing H_2S in acidic medium
- (C) Only Mn^{2+} show the formation of precipitate by passing H_2S in faintly basic medium
- (D) Cu^{2+}/Cu has higher reduction potential than Mn^{2+}/Mn (measured under similar conditions)

3. Aniline reacts with mixed acid (cone. HNO_3 and cone. H_2SO_4) at 288 K to give $P(51\%), Q(47\%)$ and $R(51%), Q(47\%)$ and $R(2\%)$. The major product(s) of the following reaction sequence is (are)

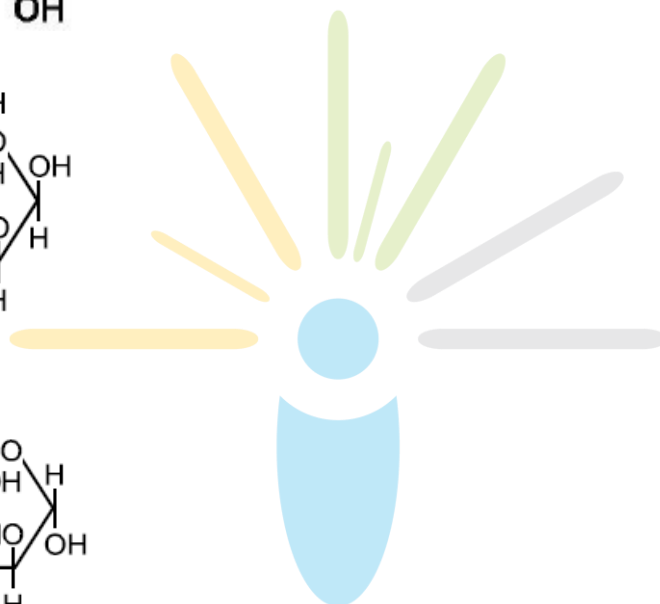
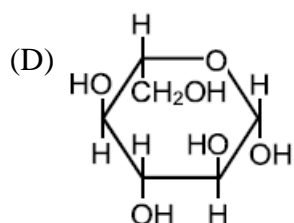
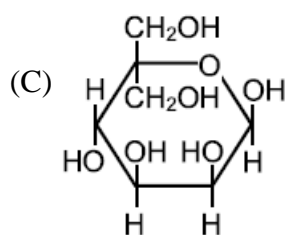
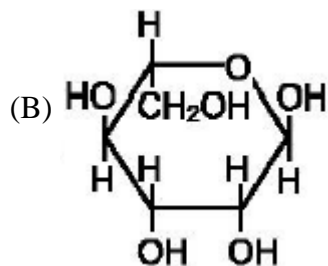
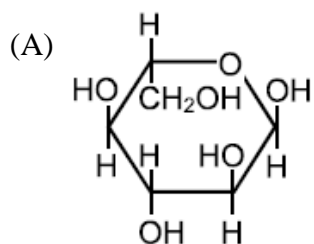




4. The Fischer presentation of *D*-glucose is given below.

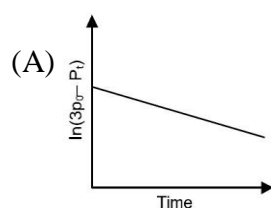


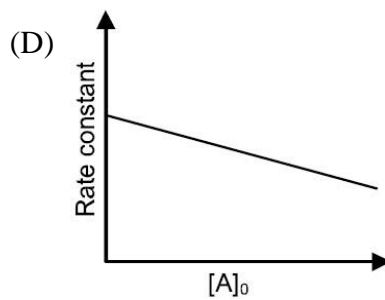
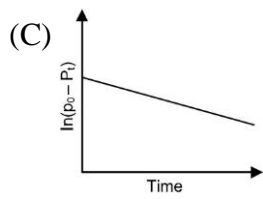
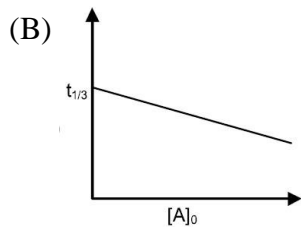
The correct structure(s) of β -*L*-glucopyranose is (are)



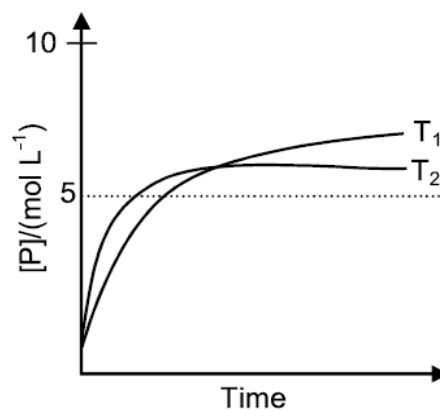
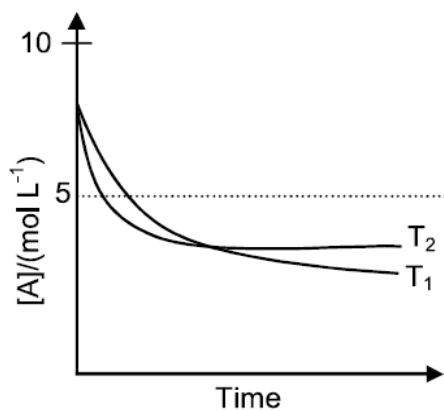
5. For a first order reaction $A(g) \rightarrow 2B(g) + C(g)$ at constant volume and 300 K, the total pressure at the beginning ($t=0$) and at time t are P_0 and P_t , respectively. Initially, only A is present with concentration $[A]_0$, and $t_{1/3}$ is the time required for the partial pressure of A to reach $1/3^{rd}$ of its initial value. The correct option(s) is (are)

(Assume that all these gases behave as ideal gases)





6. For a reaction, $A \rightleftharpoons P$, plots of $[A]$ and $[P]$ with time at temperature T_1 and T_2 are given below.



If $T_2 > T_1$, the correct statement(s) is (are)

(Assume ΔH^θ and ΔS^θ are independent of temperature and ratio of $\ln K$ at T_1 to $\ln K$ at T_2 is greater than $\frac{T_2}{T_1}$. Here H, S, G and K are enthalpy, entropy, Gibbs energy and equilibrium constant, respectively.)

(A) $\Delta H^\theta < 0, \Delta S^\theta < 0$

(B) $\Delta G^\theta < 0, \Delta H^\theta > 0$

(C) $\Delta G^\theta < 0, \Delta S^\theta < 0$

(D) $\Delta G^\theta < 0, \Delta S^\theta > 0$



SECTION II

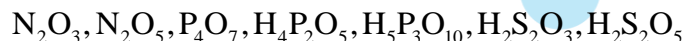
(Maximum Marks: 24)

- This section contains **EIGHT (08)** questions. The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -30, 30.27, -127.30) 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 : 3 If **ONLY** the correct numerical value is entered as answer.

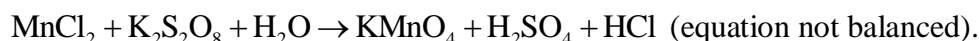
Zero Marks : 0 In all other cases.

7. The total number of compounds having at least one bridging oxo group among the molecules given below is _____.



8. Galena (an ore) is partially oxidized by passing air through it at high temperature. After some time, the passage of air is stopped, but the heating is continued in a closed furnace such that the contents undergo self-reduction. The weight (in kg) of *Pb* produced per kg of O_2 consumed is _____.

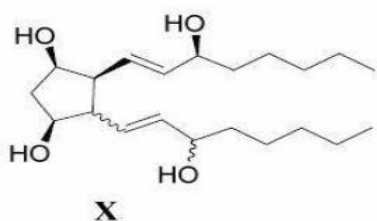
9. To measure the quantity of MnCl_2 dissolved in an aqueous solution, it was completely converted to KMnO_4 using the reaction.



Few drops of concentrated HCl were added to this solution and gently warmed. Further, oxalic acid (225 mg) was added in portions till the colour of the permanganate ion disappeared. The quantity of MnCl_2 (in mg) present in the initial solution is _____.

(Atomic weights in g mol^{-1} : $\text{Mn} = 55, \text{Cl} = 35.5$)

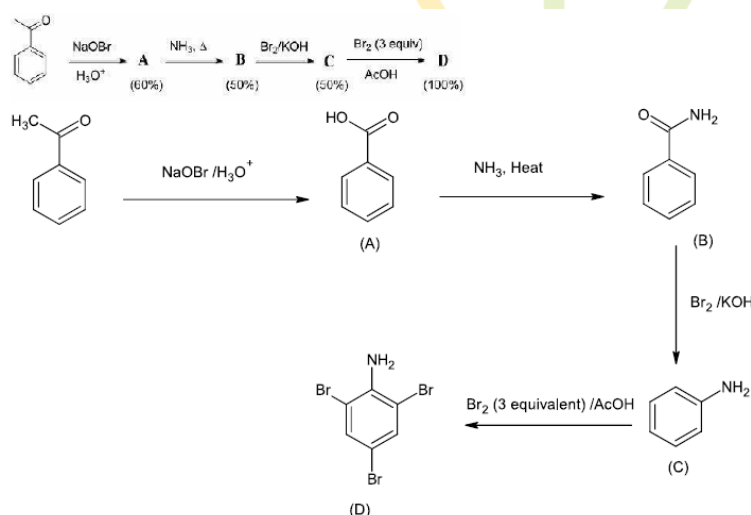
10. For the given compound X , the total number of optically active stereoisomers is.....



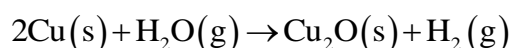
This type of bond indicates that the configuration at the specific carbon and the geometry of the double bond is fixed

This type of bond indicates that the configuration at the specific carbon and the geometry of the double bond is **NOT** fixed

11. In the following reaction sequence, the amount of D (in g) formed from 10 moles of acetophenone is... (Atomic weights in g mol^{-1} : $\text{H} = 1, \text{C} = 12, \text{N} = 14, \text{O} = 16, \text{Br} = 80$. The yield (%) corresponding to the product in each step is given in the parenthesis)



12. The surface of copper gets tarnished by the formation of copper oxide. N_2 gas was passed to prevent the oxide formation during heating of copper at 1250 K. However, the N_2 gas contains 1 mole % of water vapour as impurity. The water vapour oxidises copper as per the reaction given below:



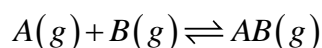
p_{H_2} is the minimum partial pressure of H_2 (in bar) needed to prevent the oxidation at 1250 K. The value of $\ln(p_{\text{H}_2})$ is _____.

(Given: total pressure = 1 bar, R (universal gas constant) = $8 J K^{-1} mol^{-1}$, $\ln(10) = 2.3$, $Cu(s)$ and $Cu_2O(s)$ are mutually immiscible.)

At 1250 K : $2Cu(s) + \frac{1}{2}O_2(g) \rightarrow Cu_2O(s); \Delta G^\circ = -78,000 J mol^{-1}$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g); \Delta G^\circ = -1,78,000 J mol^{-1}; G$ is the Gibbs energy)

13. Consider the following reversible reaction,



The activation energy of the backward reaction exceeds that of the forward reaction by $2RT$ (in $J mol^{-1}$). If the pre-exponential factor of the forward reaction is 4 times that of the reverse reaction, the absolute value of ΔG° (in $J mol^{-1}$) for the reaction at 300 K is _____.

(Given: $\ln(2) = 0.7, RT = 25000 J mol^{-1}$ at 300 K and G is the Gibbs energy)

14. Consider an electrochemical cell: $A(s) | A^{n+}(aq, 2M) || B^{2n+}(aq, 1M) | B(s)$. The value of ΔH° for the cell reaction is twice that of ΔG° at 300 K. If the emf of the cell is zero, the ΔS° (in $J K^{-1} mol^{-1}$) of the cell reaction per mole of c formed at 300 K is _____.

(Given: $\ln(2) = 0.7, R$ (universal gas constant) = $8.3 J K^{-1} mol^{-1}$. H, S and G are enthalpy, entropy and Gibbs energy, respectively.)

SECTION III

(Maximum Marks: 12)

- This section contains **FOUR (04)** questions.
- Each question has **TWO (02)** matching lists: **LIST-I** and **LIST-II**.
- **FOUR** options are given representing matching of elements from **LIST-I** and **LIST-II**. **ONLY ONE** of these four options corresponds to a correct matching.
- For each question, choose the option corresponding to the correct matching.
- For each question, marks will be awarded according to the following marking scheme:

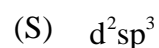
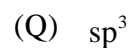
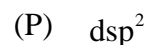
Full Marks : 3 If **ONLY** the option corresponding to the correct matching is chosen.

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

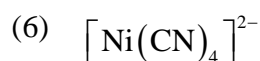
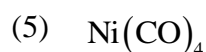
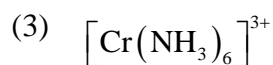
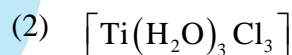
Negative Marks : 1 In all other cases.

15. Match each set of hybrid orbitals from LIST-I with complex(es) given in LIST-II.

LIST-I



LIST-II

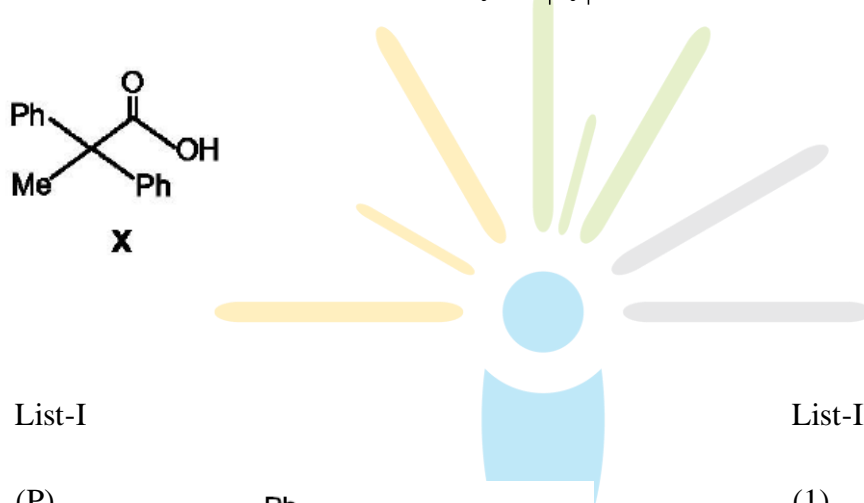


The correct option is

- (A) P → 5; Q → 4, 6; R → 2, 3; S → 1
- (B) P → 5, 6; Q → 4; R → 3; S → 1, 2
- (C) P → 6; Q → 4, 5; R → 1; S → 2, 3
- (D) P → 4, 6; Q → 5, 6; R → 1, 2; S → 3

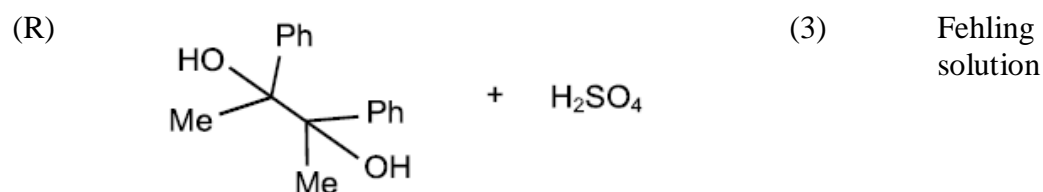
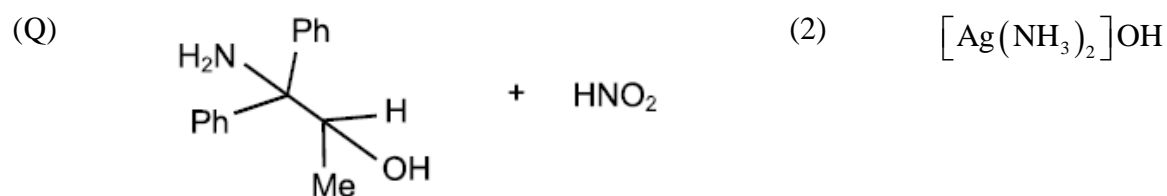
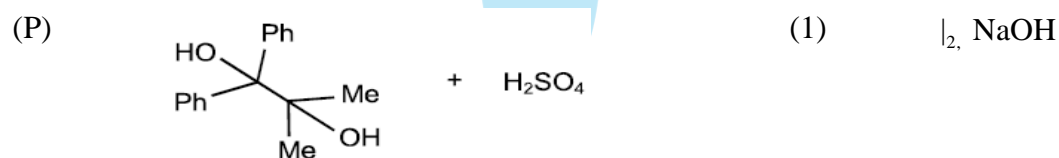
16. The desired product *X* can be prepared by reacting the major product of the reactions in LIST-I with one or more appropriate reagents in LIST-II.

(given, order of migratory aptitude: aryl > alkyl > hydrogen)

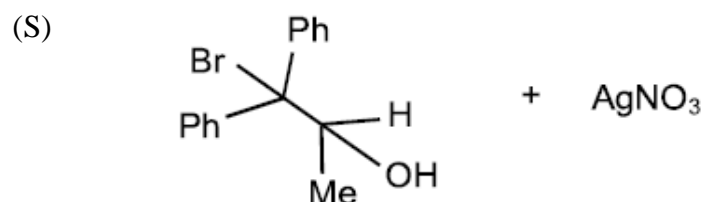
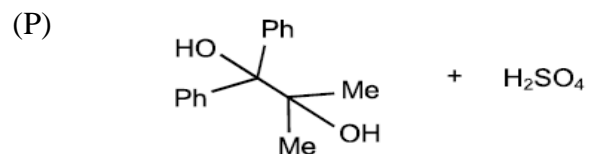


List-I

List-II



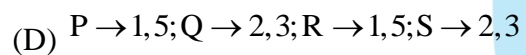
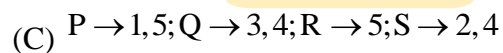
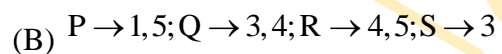
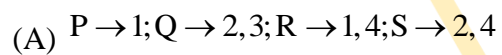
List-I



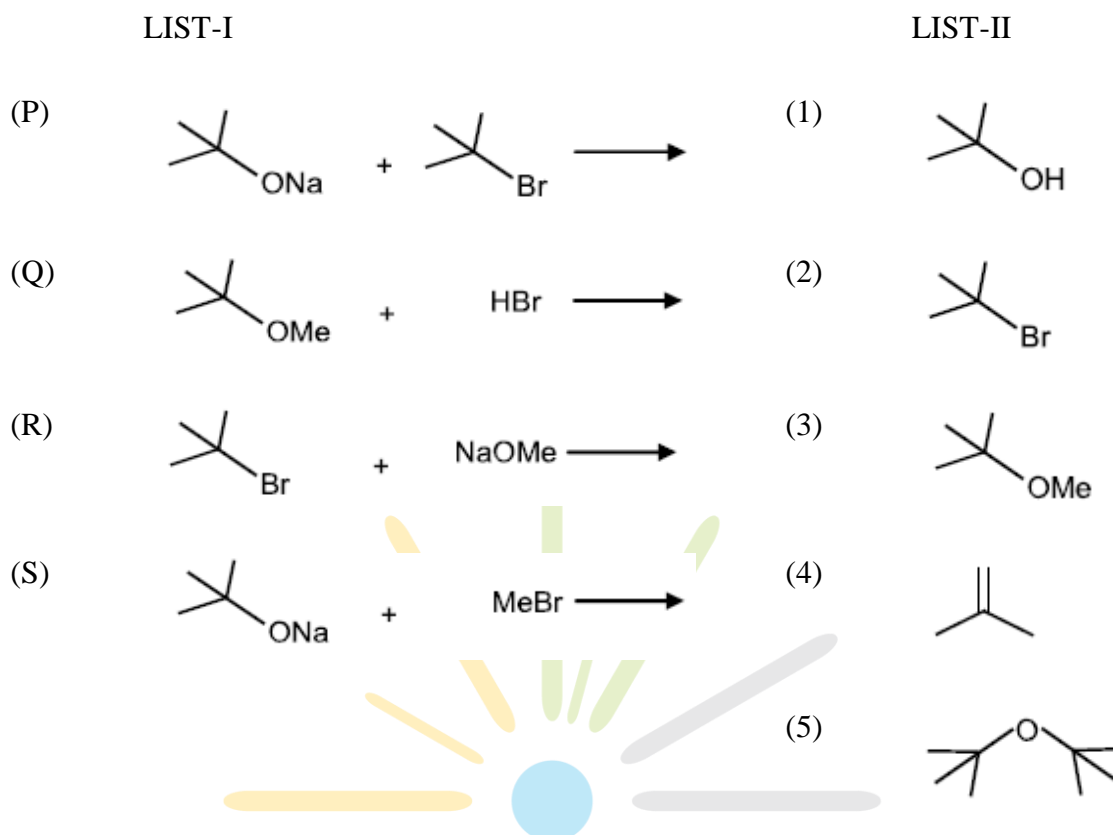
List-II



The correct option is



17. LIST-I contains reactions and LIST-II contains major products.



Match each reaction in LIST-I with one or more products in LIST-II and choose the correct option.

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

18. Dilution processes of different aqueous solutions, with water, are given in LIST-I. The effects of dilution of the solution on $[H^+]$ are given in LIST-II.

(Note : degree of dissociation (α) of weak acid and weak base is \ll ; degree of hydrolysis of salt \ll 1; $[H^+]$ represents the concentration of H^+ ions)

LIST-I

LIST-II

(P)(10 mL of 0.1 M NaOH + 20 mL of 0.1 M acetic acid) diluted to 60 mL

(1) the value of $[H^+]$ does not change on dilution

(Q)(20 mL of 0.1 M NaOH + 20 mL of 0.1 M acetic acid) diluted to 80 mL

(2) the value of $[H^+]$ changes to half of its initial value on dilution

(R)(20 mL of 0.1 M HCl + 20 mL of 0.1 M ammonia solution) diluted to 80 mL

(3) the value of $[H^+]$ changes to two times of its initial value on dilution

(S) 10 mL saturated solution of $Ni(OH)_2$ in equilibrium with excess solid $Ni(OH)_2$ is diluted to 20 mL (solid $Ni(OH)_2$ is still present after dilution).

(4) the value of $[H^+]$ changes to $\frac{1}{\sqrt{2}}$ times of its initial value on dilution

(5) the value of $[H^+]$ changes to $\sqrt{2}$ times of its initial value on dilution

Match each process given in LIST-I with one or more effect(s) in LIST-II. the correct option is

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

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

(C) $P \rightarrow 1; Q \rightarrow 4; R \rightarrow 5; S \rightarrow 3$

(D) $P \rightarrow 1; Q \rightarrow 5; R \rightarrow 4; S \rightarrow 1$