JEE(ADVANCED)-2013 PAPER 2

CHEMISTRY

INSTRUCTIONS

A. General:

1. This booklet is your Question paper. Do not break the seats of this booklet before being instructed to do so by the invigilators.
2. Blank spaces and blank pages are provided in this booklet for your rough work. No additional sheets will be provided for rough work.
3. Write your Name, roll number in the space provided on the back cover of this booklet
4. Answers to the questions and personal details are to be filled on a two-part carbon-less paper, which is provided separately. You should not separate these parts. The invigilator will separate them at the end of examination. The upper sheet is machine-gradable Objective Response Sheet (ORS) which will be taken back by the invigilator. You will be allowed to take away the bottom sheet at the end of the examination.
5. **Using a black ball point pen, darken the bubbles on the upper original sheet.** Apply sufficient pressure so that the impression is created on the bottom sheet.

B. Question Paper Format :

6. The question paper consists of three sections.
   Section 1 contains **8 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**
7. **Section 2** contains **4 paragraphs** each describing theory, experiment etc. **Eight questions** relate to four paragraphs with two questions on each paragraph. Each question of paragraph has **ONLY ONE correct answer** among the four choices (A), (B), (C) and (D).
8. **Section 3** contains **4 multiple choice questions** relate to four paragraphs with two questions on each paragraph. Each question of paragraph has **ONLY ONE correct answer** among the four choices (A), (B), (C) and (D).

D. Marking Scheme

9. For each question in **Section 1,** you will be awarded **3 marks** if you darken the bubble corresponding to the correct answer and **zero mark** if no bubbles are darkened. In all cases, **minus one (-1) mark** will be awarded
10. For each question in **Section 2 and 3,** you will be awarded 3 **marks** if you darken all the bubble corresponding to the correct answer and **zero mark** if no bubbles are darkened. In all other cases, **minus one (-1) mark** will be awarded.

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SECTION - 1 (One or more options correct Type)

This section contains **8 multiple choice questions**. Each question has four choices (A), (C), (B) and (D) out of which **ONE OR MORE** are correct.

*21. The K_{sp} of Ag_2CrO_4 is 1.1×10^{-12} at $298K$. The solubility (in mol/L) of Ag_2CrO_4 in a $0.1M \, AgNO_3$ solution is
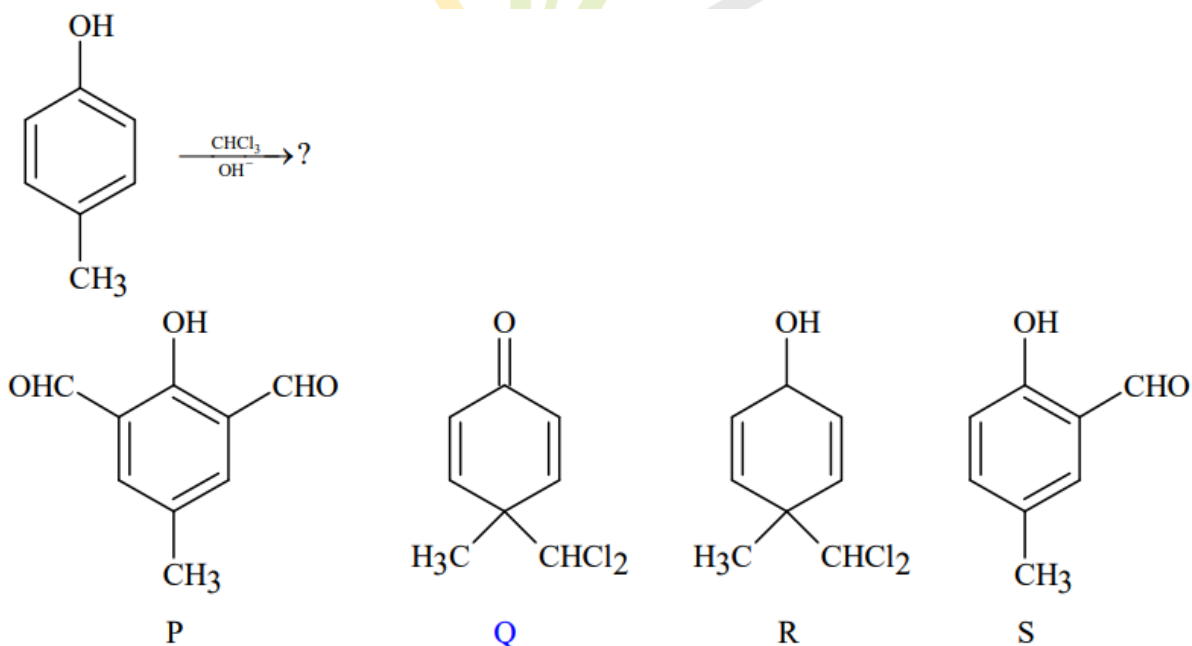
(A) 1.1×10^{-11}

(B) 1.1×10^{-10}

(C) 1.1×10^{-12}

(D) 1.1×10^{-9}

22. In the following reaction, the product (s) formed is(are)

(A) $P(\text{major})$

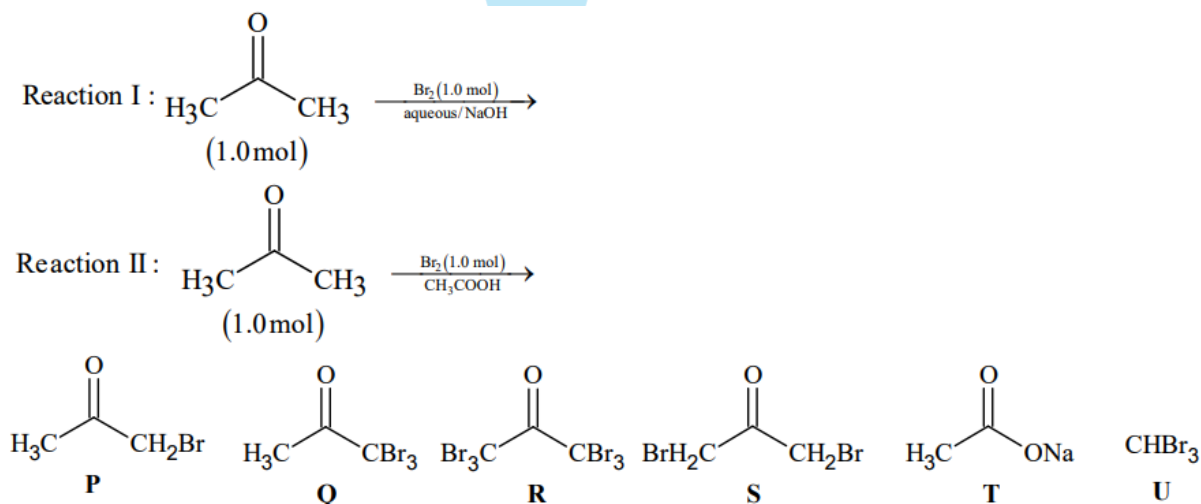(B) $Q(\text{minor})$

(C) $R(\text{minor})$

(D) $S(\text{major})$

23. The major product (s) of the following reaction is (are)

(A) P

(B) Q

(C) R

(D) S
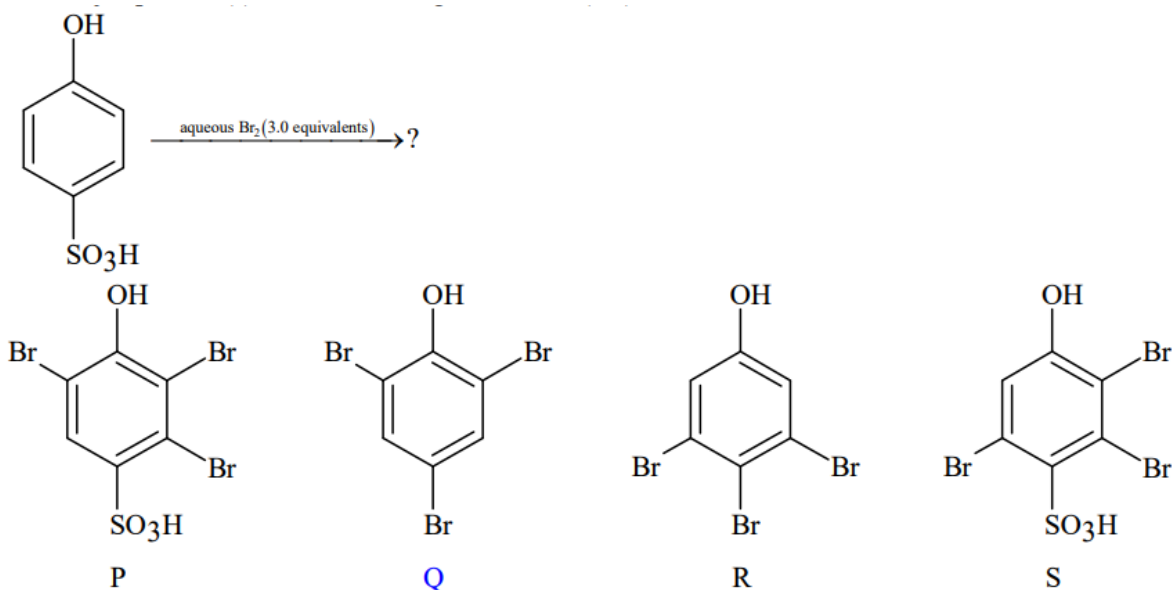
24. Alter completion of the reactions $(I \text{ and } II)$, the organic compound (s) in the reaction mixtures is(are)


(A) Reaction $I : P$ and Reaction $II : P$

(B) Reaction $I : U$, acetone and Reaction $II : Q$, acetone

(C) Reaction $I : T, U$, acetone and Reaction $II : P$

(D) Reaction $I : R$, acetone and Reaction $II : S$, acetone
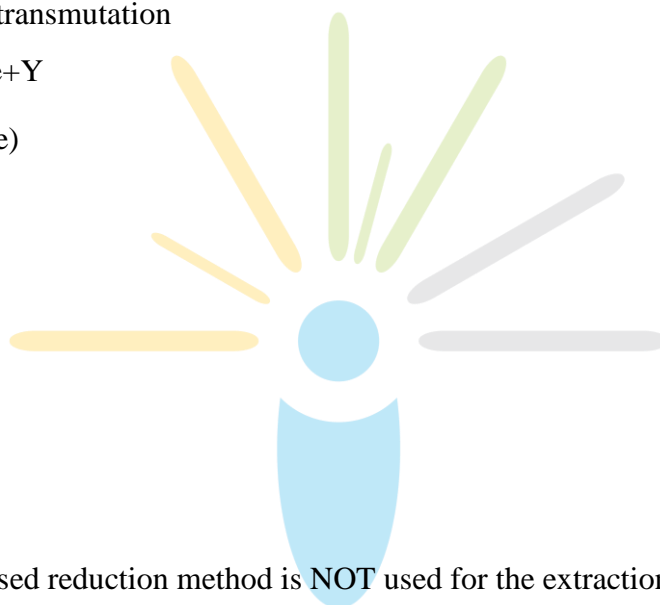
25. The correct statement (s) about O_3 is(are)

(A) O-O bond lengths are equal.

(B) Thermal decomposition of O_3 is endothermic.

(C) O_3 is diamagnetic in nature.

(D) O_3 has a bent structure.

26. In the nuclear transmutation

$$_4^9\text{Be} + \text{X} \rightarrow {}_4^8\text{Be} + \text{Y}$$

(X, Y) is (are)

(A) (γ, n)

(B) (p, D)

(C) (n, D)
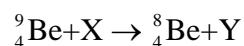
(D) (γ, p)

27. The carbon-based reduction method is NOT used for the extraction of

(A) tin from SnO_2

(B) iron from Fe_2O_3

(C) aluminium from Al_2O_3

(D) magnesium from $MgCO_3.CaCO_3$.,

28. The thermal dissociation equilibrium of $CaCo_3(s)$ is studied under different conditions.

$$CaCo_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

For this equilibrium, the correct statement (s) is(are)

(A) ΔH AH is dependent on T

(B) K is independent of the initial amount of $CaCO_3$

(C) K is dependent on the pressure of CO_2 at a given T

(D) ΔH is independent of the catalyst, if any

SECTION-2 (Paragraph Type)

This section contains **4 paragraphs** each describing theory, experiment, data etc. **Eight questions** relate to four paragraphs with two questions on each paragraph. Each question of paragraph has **only one correct answer** among four choices (A), (B), (C), and (D).

Paragraph for Question Nos. 29 and 30

An aqueous solution of a mixture of two inorganic salts, when treated with dilute HCl, gave a precipitate (P) and a filtrate (Q). The precipitate P was found to dissolve in hot water. The filtrate (Q) remained unchanged, when treated with ITS in a dilute mineral acid medium. However, it gave a precipitate (R) with H_2S in an ammoniacal medium. The precipitate R gave a coloured solution (S), when treated with H_2O_2 in an aqueous $NaOH$ medium.

29.   The precipitate P contains

   (A) Pb^{2+}

   (B) Hg_2^{2+}

   (C) Ag^+

   (D) Hg^{2+}

30.   The coloured solution S contains

   (A) $Fe_2(SO_4)_3$

   (B) $CuSO_4$

   (C) $ZnSO_4$

   (D) Na_2CrO_4
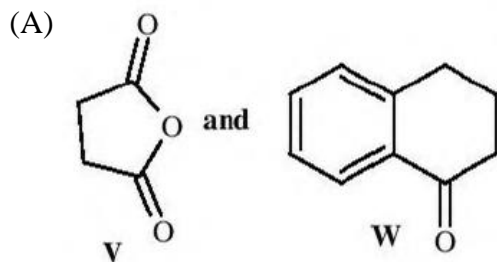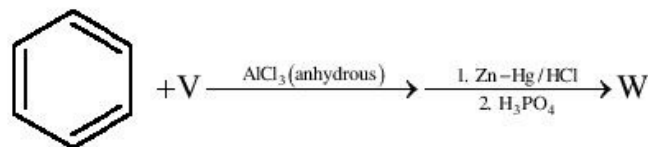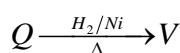
Paragraph for Question Nos. 31 to 32

P and Q are isomers of dicarboxylic acid $C_4H_4O_4$. Both decolorize Br_2/H_2O. On heating, P forms the cyclic anhydride.
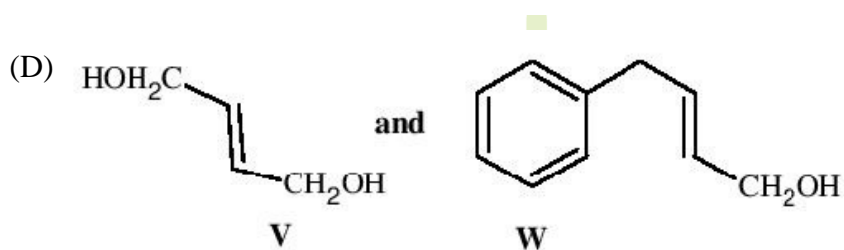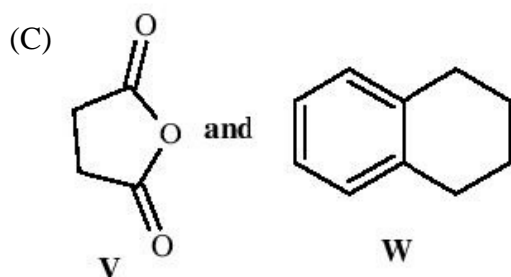
Upon treatment with dilute alkaline $KMnO_4$, P as well as Q could produce one or more than one from S, T and U.
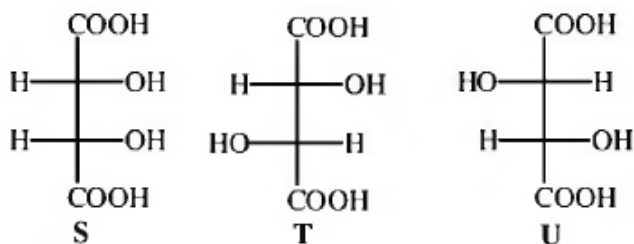
*31. Compounds formed from P and Q are, respectively

(A) Optically active S and optically active pair (T, U)

(B) Optically inactive S and optically inactive pair (T, U)

(C) Optically active pair (T, U) and optically active S

(D) Optically inactive pair (T, U) and optically inactive S

*32. In the following reaction sequences V and W are, respectively

$$Q \xrightarrow[\Delta]{H_2/Ni} V$$

$$+V \xrightarrow{AlCl_3 (anhydrous)} \xrightarrow[2.\ H_3PO_4]{1.\ Zn-Hg/HCl} W$$

(A)

and

(B)

(C)

(D)
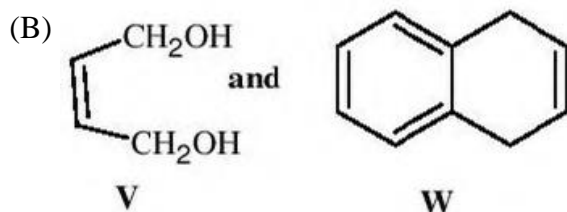
Paragraph for Question Nos. 33 to 34

A fixed mass $'m'$ of a gas is subjected to transformation of states from K to L to M to N and back to K as shown in the figure
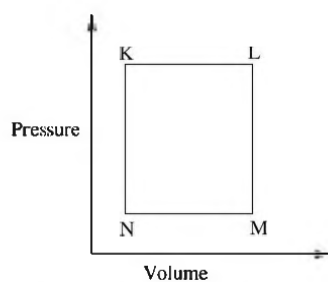
*33.   The succeeding operations that enable this transformation of states are

(A) Heating, cooling, heating, cooling

(B) Cooling, heating, cooling, heating

(C) Heating, cooling, cooling, heating

(D) Cooling, heating, heating, cooling

*34. The pair of isochoric processes among the transformation of states is

(A) K to L and L to M

(B) L to M and N to K

(C) L to M and M to N

(D) M to N and N to K

Paragraph for Question Nos. 35 to 36

The reactions of Cl_2, gas with cold-dilute and hot-concentrated $NaOH$ in water give sodium salts of two (different) oxoacids of chlorine, P and Q, respectively. The Cl_2, gas reacts with SO_2 gas, in presence of charcoal, to give a product R. R reacts with white phosphorus to give a compound S. On hydrolysis, S gives an oxoacid of phosphorus, **and T.**

35. P and Q, respectively, are the sodium salts of

(A) hypochlorous and chloric acids

(B) hypochlorous and chlorous acids

(C) chloric and perchloric acids

(D) chloric and hypochlorous acids

36. R, S and T, respectively, are

(A) SO_2Cl_2, PCl_5 and H_3PO_4

(B) SO_2Cl_2, PCl_3 and H_3PO_3

(C) $SOCl_2, PCl_3$ and H_3PO_2

(D) $SOCl_2, PCl_5$ and H_3PO_4

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SECTION-3: (Matching List Type)

This section contains **4 multiple choice questions. Each question has matching lists.** The codes for the lists have choices (), (), () and () out of which **ONLY ONE** is correct.

37. The unbalanced chemical reactions given in List-I show missing reagent or condition (?) which are provided in List-II. Match List -I with List II and select the correct answer using the code given below the lists:

	List I	List II
(P)	$PbO_2 + H_2SO_4 \xrightarrow{?} PbSO_4 + O_2 + other\ product$	(1) NO
(Q)	$Na_2S_2O_3 + H_2O \xrightarrow{?} NaSO_4 + other\ product$	(2) I_2
(R)	$N_2H_4 \xrightarrow{?} N_2 + other\ product$	(3) $Warm$
(S)	$XeF_2 \xrightarrow{?} Xe + other\ product$	(4) Cl_2

Codes:

(A)
P	Q	R	S
4	2	3	1

(B)
P	Q	R	S
3	2	1	4

(C)
P	Q	R	S
1	4	2	3

(D)
P	Q	R	S
3	4	2	1

38. Match the chemical conversions in List -I with appropriate reagents in List II and select the correct answer using the code given below the lists:
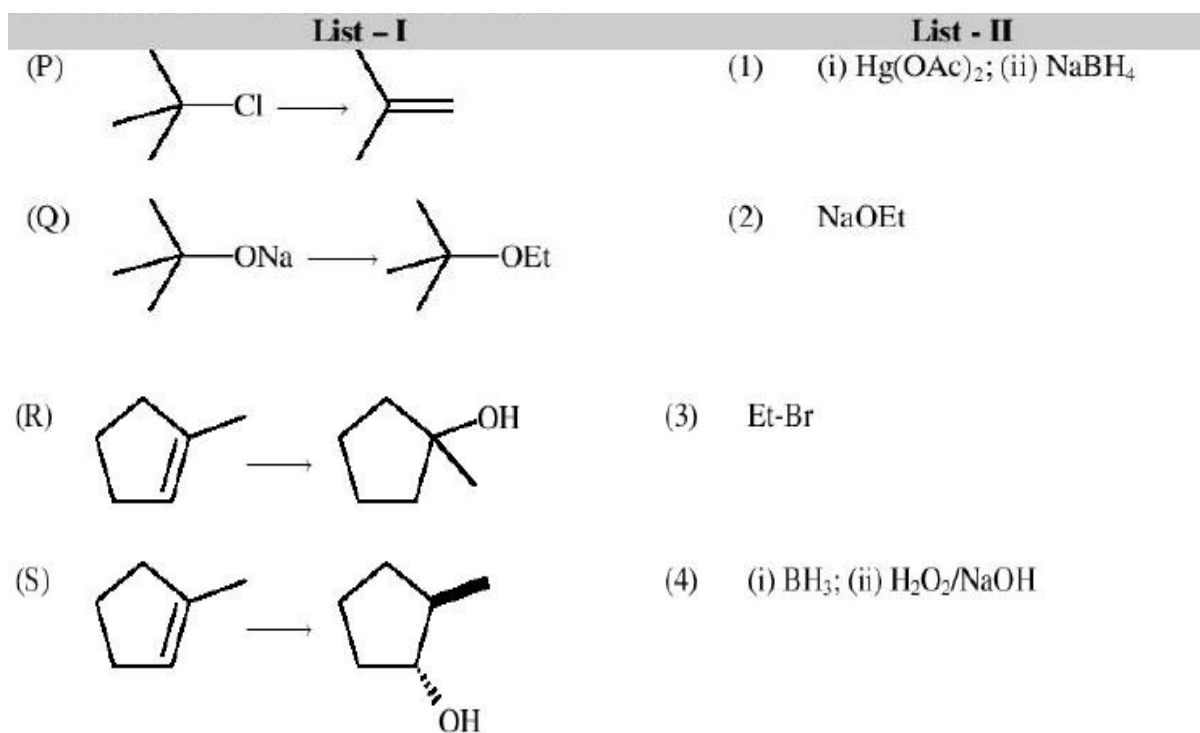
List – I	List - II
(P) —Cl ⟶	(1) (i) $Hg(OAc)_2$; (ii) $NaBH_4$
(Q) —ONa ⟶ —OEt	(2) NaOEt
(R) ⟶ OH	(3) Et-Br
(S) ⟶ OH	(4) (i) BH_3; (ii) $H_2O_2/NaOH$

Codes:

(A)
P	Q	R	S
2	3	1	4

(B)
P	Q	R	S
3	2	1	4

(C)
P	Q	R	S
2	3	4	1

(D)
P	Q	R	S
3	2	4	1

39. An aqueous solution of X is added slowly to an aqueous solution of Y as shown in List – I. The variation in conductivity of these reactions in List – II. Match List -I with List II and select the correct answer using the code given below the lists:

	List I		List II
(P)	$(C_2H_5)N+CH_3COOH$	(1)	*Conductivity decreases and then increase*
(Q)	$KI\underset{X}{(0.1M)}+AgNO_3\underset{X}{(0.01M)}$	(2)	*Conductivity decreases and then does not change much*
(R)	$CH_3\underset{X}{COOH}+K\underset{Y}{OH}$	(3)	*Conductivity increases and then does not change much*
(S)	$Na\underset{X}{OH}+H\underset{Y}{I}$	(4)	*Conductivity does not change much and then increases*

Codes:

(A)
$$\begin{array}{cccc} P & Q & R & S \\ 3 & 4 & 2 & 1 \end{array}$$

(B)
$$\begin{array}{cccc} P & Q & R & S \\ 4 & 3 & 2 & 1 \end{array}$$

(C)
$$\begin{array}{cccc} P & Q & R & S \\ 2 & 3 & 4 & 1 \end{array}$$

(D)
$$\begin{array}{cccc} P & Q & R & S \\ 1 & 4 & 3 & 2 \end{array}$$

40. The standard reduction potential data at $25°C$ is given below:

$$E^0\left(Fe^{3+}, Fe^{2+}\right) = +0.77V;$$
$$E^0\left(Fe^{2+}, Fe\right) = -0.44V$$
$$E^0\left(Cu^2, Cu\right) = +0.34V;$$
$$E^0\left(Cu^2, Cu\right) = +0.54V$$
$$E^0\left[O_2(g) + 4H^+ + 4e^- \rightarrow 2H_2O\right] = +1.23V;$$
$$E^0\left[O_2(g) + 2H_2O + 4e^- \rightarrow 4OH_2\right] = +0.40V$$
$$E^0\left(Cr^{3+}, Cr\right) = -0.74V;$$
$$E^0\left(Cr^{2+}, Cr\right) = -0.91V$$

Match E0 of the redox pair in List – I with the values given in List – II and select the correct answer using the code given below the lists

(P) $E^0\left(Fe^{3+}, Fe\right)$ (1) $-0.18V$

(Q) $E^0\left(4H_2O \rightleftharpoons 4H^+ + 4OH^-\right)$ (2) $-0.4V$

(R) $E^0\left(Cu^{2+} + Cu \rightarrow 2Cu^+\right)$ (3) $-0.04V$

(S) $E^0\left(Cr^{3+}, Cr^{2+}\right)$ (4) $-0.83V$

Codes:

(A)
P	Q	R	S
4	1	2	3

(B)
P	Q	R	S
2	3	4	1

(C)
P	Q	R	S
1	2	3	4

(D)
P	Q	R	S
3	4	1	2