CAREER POINT

JEE Advanced Exam 2019
(Paper & Solution)

Date : 27 / 05 / 2019

PAPER-2

PART-I (CHEMISTRY)

SECTION – 1 (Maximum Marks : 32)

- This section contains **EIGHT (08)** questions
- Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose(s) corresponding to (all) the correct answer(s).
- 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 option is chosen (i.e. the question is unanswered).
Negative Marks	: **–1**	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 comination of options will get –1 mark

Q.1 The cyanide process of gold extraction involves leaching out gold from its ore with CN^- in the presence of Q in water to form R. Subsequently, R is treated with T to obtain Au and Z. Choose the correct options(s)

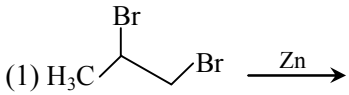
(1) Z is $[Zn(CN)_4]^{2-}$ (2) T is Zn (3) Q is O_2 (4) R is $[Au(CN)_4]^-$

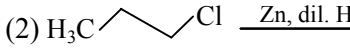
Ans. **[1,2,3]**

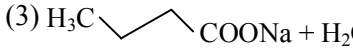
Sol. $$\underset{Q}{Au + CN^-(aq.) + O_2} \xrightarrow{H_2O} [Au(CN)_2]^-(aq.) + OH^-$$

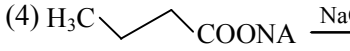
$$\underset{(R)}{[Au(CN)_2]^-(aq.)} + \underset{(T)}{Zn(s)} \rightarrow \underset{(Z)}{[Zn(CN)_4]^{2-}} + 2Au(s)$$

Q.2 Which of the following reactions produce(s) propane as a major product ?

(1)  $\xrightarrow{Zn}$

(2)  $\xrightarrow{Zn,\ dil.\ HCl}$

(3)  $+ H_2O \xrightarrow{electrolysis}$

(4)  $\xrightarrow{NaOH,\ CaO,\ \Delta}$

Ans. **[2,4]**

Sol. $CH_3–CH_2–CH_2–Cl \xrightarrow[\substack{Reduction\\ +1\ +Cl}]{Zn} CH_3–CH_2–CH_3$

$CH_3–CH_2–CH_2–\underset{\underset{O}{\|}}{C}–O^{\ominus}Na^{\oplus} \xrightarrow[CaO]{NaOH^{+}} CH_3–CH_2–CH_3$

Q.3 With reference to aqua regia, choose the correct option(s)

(1) Reaction of gold with aqua regia produces NO_2 in the absence of air

(2) Reaction of gold with aqua produces an anion having Au in +3 oxidation state

(3) The yellow colour of aqua regia is due to the presence of NOCl and Cl_2

(4) Aqua regia is prepared by mixing conc. HCl and conc. HNO_3 in 3:1 (v/v) ratio

Ans. **[2,3,4]**

Sol. $HNO_3 + 3HCl \rightarrow NOCl + 2H_2O + 2|Cl|$

$Au + 3|Cl| \rightarrow \overset{+3}{Au}Cl_3 \xrightarrow{HCl} H\overset{+3}{Au}Cl_4$

Q.4 The ground state energy of hydrogen atom is –13.6 eV. Consider an electronic state ψ of He^+ whose energy, azimuthal quantum number and magnetic quantum number are –3.4 eV, 2 and 0, respectively. Which of the following statement(s) is(are) true for the state ψ ?

(1) The nuclear charge experienced by the electron in this state is less than 2e, where e is the magnitude of the electronic charge

(2) It has 2 angular nodes

(3) It has 3 radial nodes

(4) It is a 4d state

Ans. **[2,4]**

Sol. $He^+ = (z = 2)$

$E_n = -13.6 \frac{z^2}{n^2} = -3.4$

$-13.6 \frac{(2)^2}{n^2} = -3.4$

$n^2 = 4^2$

$n = 4$

$x = 4,\ \ell = 2,\ m = 0 \qquad (4dz^2)$

1. Nuclear charge = + 2e
2. Angular Nodes = $\ell = 2$
3. Radial Nodes = $n - \ell - 1 = 4 - 2 - 1 = 1$
4. 4d

Q.5 Choose the correct option(s) from the following

(1) Cellulose has only α-D-glucose units that are joined by glycosidic linkages

(2) Natural rubber is polyisoprene containing trans alkene units

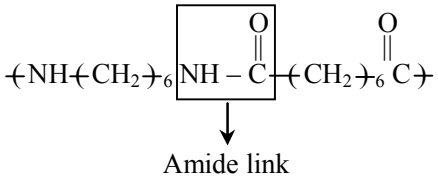
(3) Nylon-6 has amide linkages

(4) Teflon is prepared by heating tetrafluoroethene in presence of a persulphate catalyst at high

Ans. **[3,4]**

Sol. (1) Cellulose has β-D-glucose

(2) Natural Rubber → Polyisoprene (cis form)

(3) 

(4) $CF_2 = CF_2 \xrightarrow{2SO_4^{\ominus}\cdot} (CF_2 - CF_2)_n$

Q.6 Consider the following reactions (unbalanced)

Zn + hot conc. $H_2SO_4 \rightarrow G + R + X$

Zn + conc. $NaOH \rightarrow T + Q$

$G + H_2S + NH_4OH \rightarrow Z$ (a precipitate) $+ X + Y$

Choose the correct option(s)

(1) Bond order of Q is 1 in its ground state (2) Z is dirty white is colour

(3) R is a V-shaped molecule (4) The oxidation state of Zn in T is +1

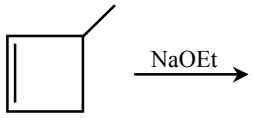
Ans. **[1,2,3]**

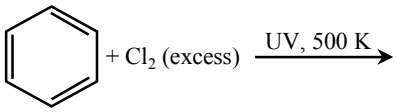
Sol. $Zn + \text{Hot ConC} \cdot H_2SO_4 \longrightarrow \underset{(G)}{ZnSO_4} + \underset{(R)}{SO_2} + \underset{(X)}{H_2O}$

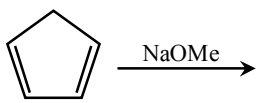
$Zn + \text{ConC} \cdot NaOH \longrightarrow \underset{(T)}{Na_2\overset{+2}{Zn}O_2} + \underset{(Q)}{H_2}\,(B \cdot O = 1)$

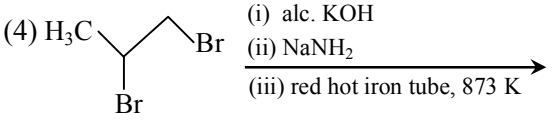
$ZnSO_4 + H_2S + NH_4OH \longrightarrow \underset{(Z)\ \text{(Dirty white)}}{ZnS\downarrow} + \underset{(Y)}{(NH_4)_2SO_4} + \underset{(X)}{H_2O}$

Q.7 Choose the correct option(s) that give(s) an aromatic compound as the major product

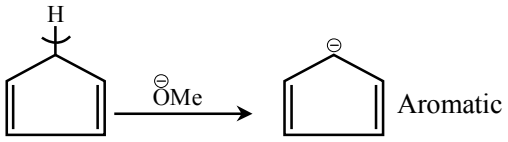
(1) 

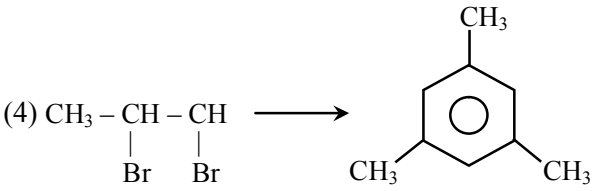
(2) 

(3) 

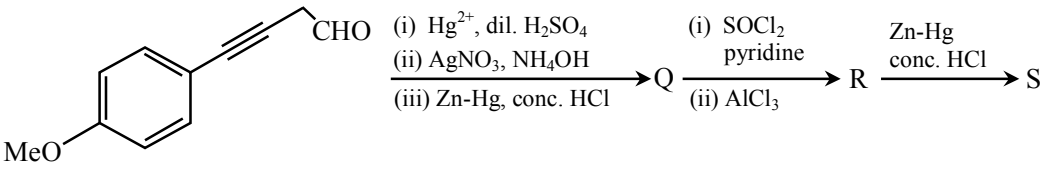
(4) 

Ans. **[3,4]**

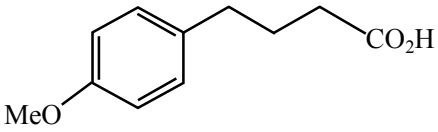
Sol. (3) 

(4) 

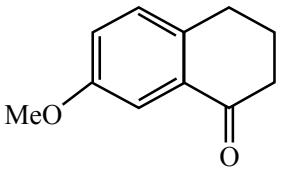
Q.8 Choose the correct option(s) for the following reaction sequence



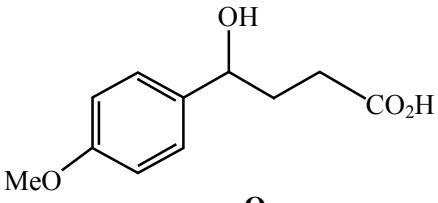
Consider Q, R and S as major products

(1) 

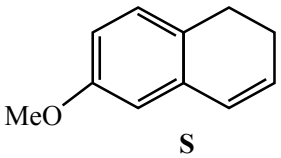
Q



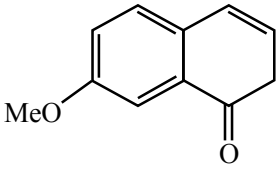
R

(2) 

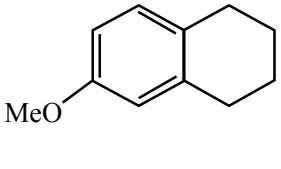
Q



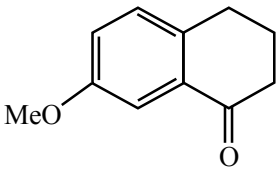
S

(3) 

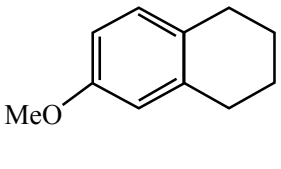
R



S

(4) 

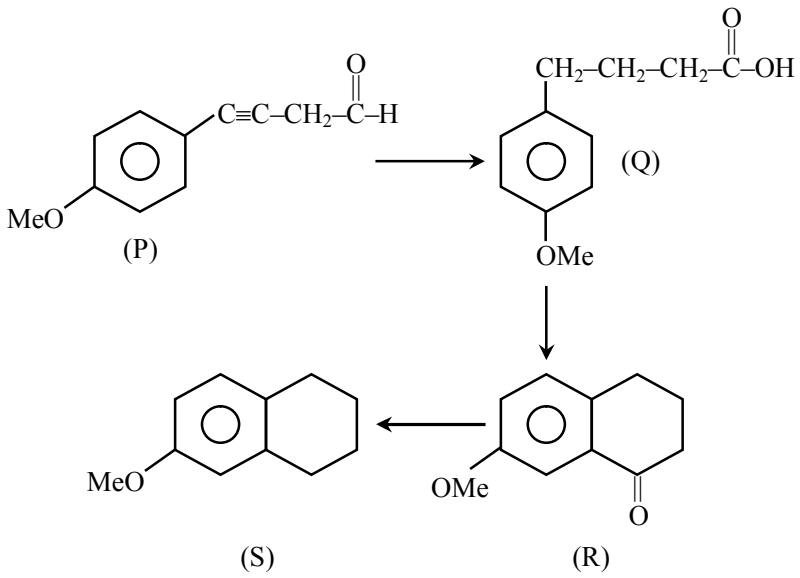
R



S

Ans. **[1,4]**

Sol.



SECTION – 2 (Maximum Marks : 18)

- This section contains **SIX (06)** questions. The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value 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 ot TWO decimal places.
- 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.

Q.1 The amount of water produced (in g) in the oxidation of 1 mole of rhombic sulphur by conc. HNO_3 to a compound with the highest oxidation state of sulphur is _____

(Given data : Molar mass of water = 18 g mol^{-1})

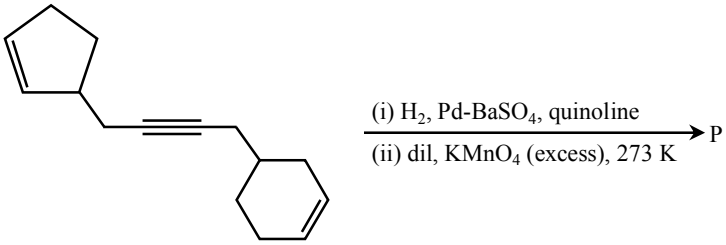
Ans. **[288 gm]**

Sol. $S_8 + 48\ HNO_3 \longrightarrow 8\ H_2SO_4 + 48\ NO_2 + 16\ H_2O$

Mole of water = 18

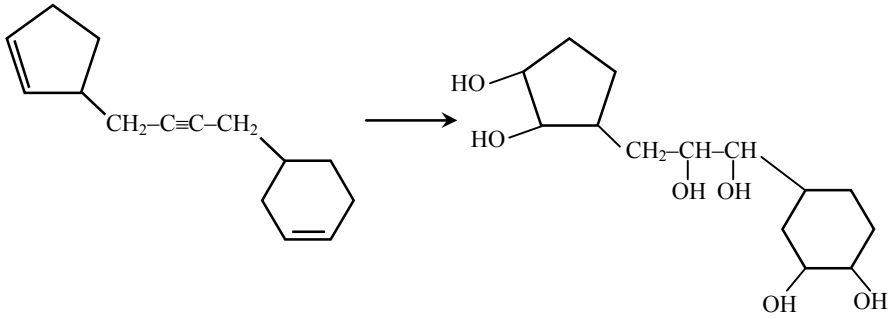
Amount of water produced = $16 \times 18 = 288$ gm

Q.2 Total number of hydroxyl groups present in a molecule of the major product P is _____



Ans. **[6]**

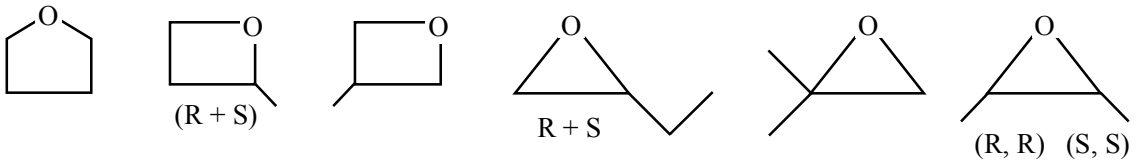
Sol.



Q.3 Total number of isomers, considering both structural and stereoisomers, of cyclic ethers with the molecular formula C_4H_8O is _____

Ans. **[10]**

Sol.



= 10

Q.4 The mole fraction of urea in an aqueous urea solution containing 900 g of water is 0.05. If the density of the solution is 1.2 g cm^{-3}, the molarity of urea solution is _____

(Given data : Molar masses of urea and water are 60 g mol^{-1} and 18 g mol^{-1}, respectively)

Ans. **[2.98]**

Sol. mole fraction urea

$$X = \frac{n_A}{n_A + n_B} = 0.05$$

$$\frac{n_A}{n_A + \frac{900}{18}} = 0.05$$

$$\frac{n_A}{n_A + 50} = 0.05$$

$n_A = 0.05\ n_A + 2.5$

$0.95\ n_A = 2.5$

$$n_A = \frac{2.5}{0.95} = \frac{250}{95}$$

$$\text{In Urea} = \frac{250}{95} \times 60 = 157.89$$

$$M = \frac{\text{Moles(Solute)}}{V_L\,\text{(Solution)}} = \frac{250/95}{\frac{(900+157.89)}{1.2\times1000}} = \frac{250\times1.2\times1000}{95\times1057.89} = 2.985 = 2.98M$$

Q.5 The decomposition reaction $2N_2O_5(g) \xrightarrow{\Delta} 2N_2O_4(g) + O_2(g)$ is started in a closed cylinder under isothermal isochoric condition at an initial pressure of 1 atm. After Y × 10^3 s, the pressure inside the cylinder is found to be 1.45 atm. If the rate constant of the reaction is 5 × 10^{-4} s^{-1}, assuming ideal gas behaviour, the value of Y is _____

Ans. **[2.30]**

Sol. $2N_2O_5(g) \rightleftharpoons 2\ N_2O_4\ (g) + O_2$

P_1	O	O
$P_1 - P_2$	P_2	$\frac{P_2}{2}$

$P_1 = 1$

$P_1 + \frac{P_2}{2} = 1.45$

$\frac{P_2}{2} = 1.45 - 1 = 0.45$

$P_2 = 0.9$

$k = 5 \times 10^{-4}\ sec^{-1}$

It is I order reaction.

$k_1 = \frac{2.303}{2 \times t} \log \frac{P_0}{P_t}$ $\qquad P_t = P_1 - P_2 = 1 - 0.45 = 0.55$

$5 \times 10^{-4} = \frac{2.303}{2 \times t} \log \frac{1}{0.1}$

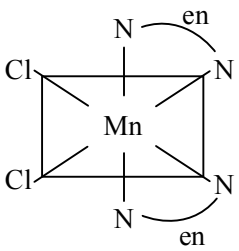
$t = \frac{2.303}{2 \times 5 \times 10^{-4}} \left[\log \frac{1.0}{0.1}\right] = \frac{2.303}{10^{-3}} \times 1 = 2.303 \times 10^3\ sec$

Hence on comparing y = 2.30 nearly rounding up to two decimal place

Q.6 Total number of cis N–Mn–Cl bond angles (that is, Mn–N and Mn–Cl bonds in cis positions) present in a molecule of cis-$[Mn(en)_2Cl_2]$ complex is _____ (en = $NH_2CH_2CH_2NH_2$)

Ans. **[6]**

Sol. $[Mn(en)_2Cl_2]$



SECTION – 3 (Maximum Marks : 12)

- This section contains **Two (02)** List-Match sets.
- Each List-Match set has **TWO (02)** Multiple Choice Questions.
- Each List-Match set has two lists : **List-I** and **List-II**
- **List-I** has **Four** entries (I), (II), (III) and (IV) and List-II has Six entries (P), (Q), (R), (S), (T) and (U).
- **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.
- 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.

Answer the following by appropriately matching the lists based on the information given in the paragraph.

Q.1 Consider the Bohr's model of a one-electron atom where the electron moves around the nucleus. In the following. List-I contains some quantities for the n^{th} orbit of the atom and List-II contains options showing how they depend on n.

	LIST-I		LIST-II
(I)	Radius of the n^{th} orbit	**(P)**	$\propto n^{-2}$
(II)	Angular momentum of the electron in the n^{th} orbit	**(Q)**	$\propto n^{-1}$
(III)	Kinetic energy of the electron in the n^{th} orbit	**(R)**	$\propto n^{0}$
(IV)	Potential energy of the electron in the n^{th} orbit	**(S)**	$\propto n^{1}$
		(T)	$\propto n^{2}$
		(U)	$\propto n^{1/2}$

(1) (III), (P) (2) (III), (S) (3) (IV), (U) (4) (IV), (Q)

Ans. **[1]**

Sol. (I) $r = 0.5\ 29\ \dfrac{n^2}{z}$

$r \propto n^2$

$I \rightarrow T$

(II) Angular momentum = $mvr = \left(\dfrac{z}{n}\right)\left(\dfrac{n^2}{z}\right) = \dfrac{nh}{2\pi}$

$An \propto n'$

$II \rightarrow S$

(III) $k \cdot E = -T \cdot E = +\ 13.6\ \dfrac{z^2}{n^2}$

$k \cdot E \propto n^{-2}$

(IV) $P \cdot E = \dfrac{T \cdot E}{2} = \dfrac{-13.6}{2}\dfrac{z^2}{n^2}$

$P \cdot E \propto n^{-2}$

$IV \rightarrow P$

Q.2 Consider the Bohr's model of a one-electron atom where the electron moves around the nucleus. In the following. List-I contains some quantities for the n^{th} orbit of the atom and List-II contains options showing how they depend on n.

	LIST-I		LIST-II
(I)	Radius of the n^{th} orbit	**(P)**	$\propto n^{-2}$
(II)	Angular momentum of the electron in the n^{th} orbit	**(Q)**	$\propto n^{-1}$
(III)	Kinetic energy of the electron in the n^{th} orbit	**(R)**	$\propto n^{0}$
(IV)	Potential energy of the electron in the n^{th} orbit	**(S)**	$\propto n^{1}$
		(T)	$\propto n^{2}$
		(U)	$\propto n^{1/2}$

(1) (I), (P) (2) (I), (T) (3) (II), (R) (4) (II), (Q)

Ans. **[2]**

Sol. $r \propto n^2$

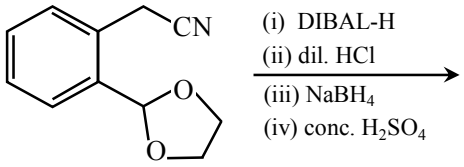
$Am \propto n^1$

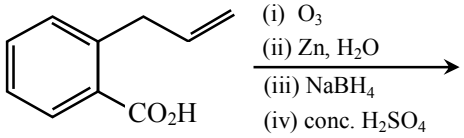
$K.E \propto n^{-2}$

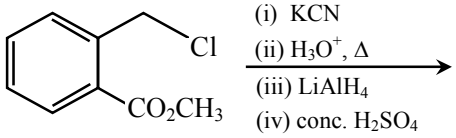
$P.E \propto n^{-2}$

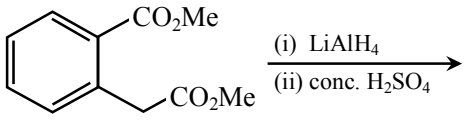
Q.3 List-I includes starting materials and reagents of selected chemical reactions. List-II gives structures of compounds that may be formed as intermediate products and/or final products from the reactions of List-I.

LIST-I

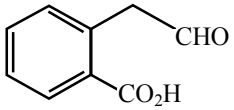
(I) 

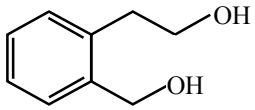
(II) 

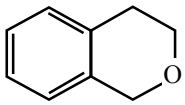
(III) 

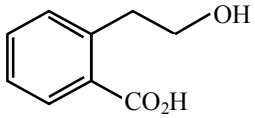
(IV) 

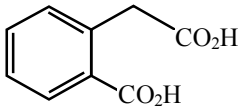
LIST-II

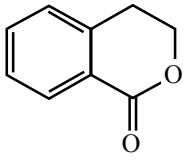
(P) 

(Q) 

(R) 

(S) 

(T) 

(U) 

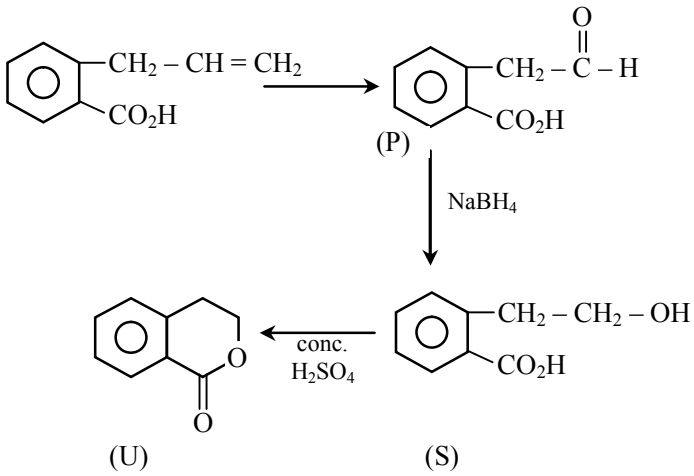
Which of the following options has correct combination considering List-I and List-II ?

(1) (I), (Q), (T), (U) (2) (II), (P), (S), (U)

(3) (II), (P), (S), (U) (4) (I), (S), (Q), (R)

Ans. **[2]**

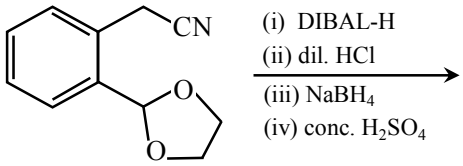
Sol.



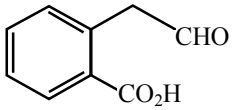
Q.4 List-I includes starting materials and reagents of selected chemical reactions. List-II gives structures of compounds that may be formed as intermediate products and/or final products from the reactions of List-I.

LIST-I **LIST-II**

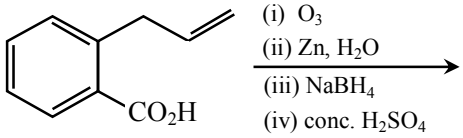
(I)



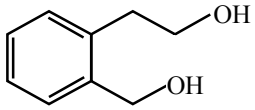
(P)



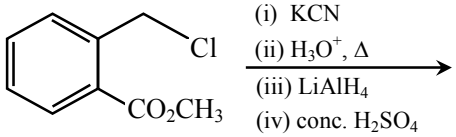
(II)



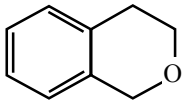
(Q)



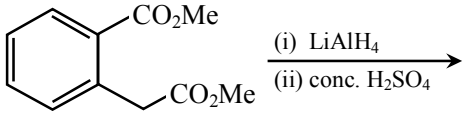
(III)



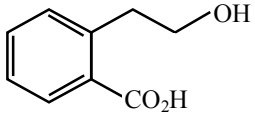
(R)



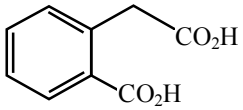
(IV)



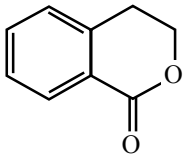
(S)



(T)



(U)



(1) (IV), (Q), (R) (2) (III), (S), (R)

(3) (IV), (Q), (U) (4) (III), (T), (U)

Ans. **[1]**

Sol.