FINAL JEE(Advanced) EXAMINATION - 2019

(Held On Monday 27th MAY, 2019)

PAPER-2 **TEST PAPER WITH ANSWER & SOLUTION**

PART-2 : 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 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	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 and 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	: –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 combination of options will get –1 mark.

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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 option(s).

(1) **T** is Zn

(2) **R** is $[Au(CN)_4]^-$

(3) **Z** is $[Zn(CN)_4]^{2-}$

(4) **Q** is O_2

Ans. (1,3,4)

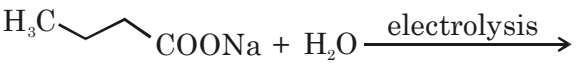
Sol. $4Au(s) + 8CN^-(aq) + 2H_2O(aq) + O_2(g) \rightarrow 4[Au(CN)_2]^-(aq) + 4OH^-(aq)$

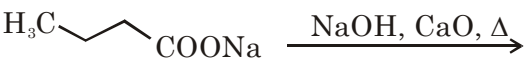
(Q)

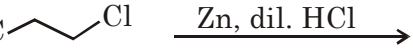
$2[Au(CN)_2]^-(aq) + Zn(s) \rightarrow [Zn(CN)_4]^{2-}(aq) + 2Au(s)$

(R) (T) (Z)

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

(1) 

(2) 

(3) 

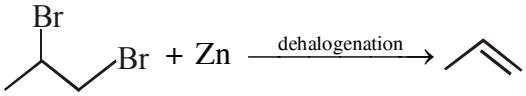
(4) 

Ans. (2,3)

Sol. $CH_3 - CH_2 - CH_2 - CO_2Na + H_2O \xrightarrow{\text{electrolysis}}$ n-hexane

$CH_3 - CH_2 - CH_2 - CO_2Na \xrightarrow[\Delta]{NaOH + CaO} CH_3 - CH_2 - CH_3$

$CH_3 - CH_2 - CH_2 - Cl + Zn \longrightarrow CH_3 - CH_2 - CH_2 - ZnCl \xrightarrow{\text{dil. HCl}} CH_3CH_2CH_3$



3. 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) It has 2 angular nodes

(2) It has 3 radial nodes

(3) It is a 4d state

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

Ans. (1,3)

Sol. # $-3.4 = \dfrac{-13.6 \times 4}{n^2}$

$n = 4$

$\ell = 2$

$m = 0$

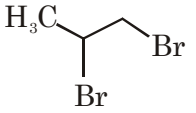
Angular nodes = $\ell = 2$

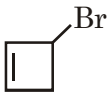
Radial nodes = $(n - \ell - 1) = 1$

$n\ell$ = 4d state

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

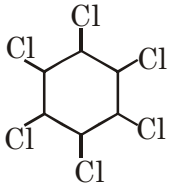
(1)  + Cl_2(excess) $\xrightarrow{UV,\ 500K}$

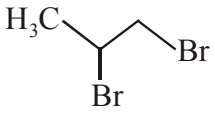
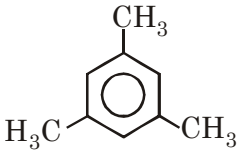
(2)  $\xrightarrow[iii)\ red\ hot\ iron\ tube,873\ K]{i)\ alc.KOH;\ ii)\ NaNH_2}$

(3)  $\xrightarrow{NaOEt}$

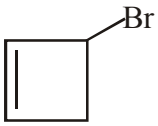
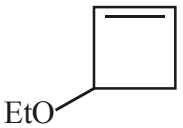
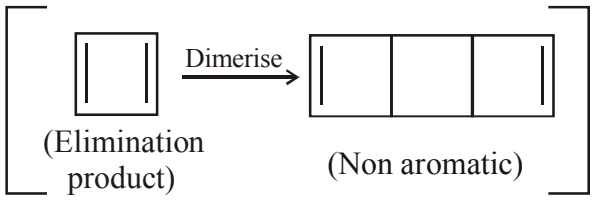
(4)  $\xrightarrow{NaOMe}$

Ans. (2,4)

Sol. (1)  + Cl_2 (excess) $\xrightarrow[500\ K]{Uv}$  (Non aromatic)

(2)  $\xrightarrow[ii)\ NaNH_2]{i)\ alc.\ KOH}$ $CH_3 - C \equiv CH$ $\xrightarrow{Red\ hot\ iron\ tube\ 873\ K}$ 

(Aromatic)

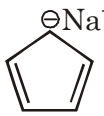
(3)  $\xrightarrow{NaOEt}$  + 

(Substitution product)

(Elimination product)

(Non aromatic)

(Non aromatic)

(4)  $\xrightarrow{NaOMe}$  + MeOH

(Aromatic ion)

5. 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) The oxidation state of Zn in T is +1

(2) Bond order of Q is 1 in its ground state

(3) Z is dirty white in colour

(4) R is a V-shaped molecule

Ans. (2,3,4)

Sol. $Zn + 2H_2SO_4$ (Hot and conc.) $\rightarrow \underset{(G)}{ZnSO_4} + \underset{(R)}{SO_2}\uparrow + \underset{(X)}{2H_2O}$

$Zn + 2NaOH$ (conc.) $\rightarrow \underset{(T)}{Na_2ZnO_2} + \underset{(Q)}{H_2}\uparrow$

$ZnSO_4 + H_2S + 2NH_4OH \rightarrow \underset{(Z)}{ZnS}\downarrow + \underset{(X)}{2H_2O} + \underset{(Y)}{(NH_4)_2SO_4}$

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

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

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

Ans. (2,3,4)

Sol. (1) $Au + HNO_3 + 4HCl \rightarrow AuCl_4^{\ominus} + H_3O^+ + NO + H_2O$

(2) Aqua regia = 3HCl(conc.) + HNO_3(conc.)

(3) $AuCl_4^{\ominus}$ is produced

(4) Yellow colour of aqua regia is due to it's decomposition into NOCl(orange yellow) and Cl_2(greenish yellow).

7. Choose the correct option(s) from the following

(1) Natural rubber is polyisoprene containing *trans* alkene units

(2) Nylon-6 has amide linkages

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

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

Ans. (2,4)

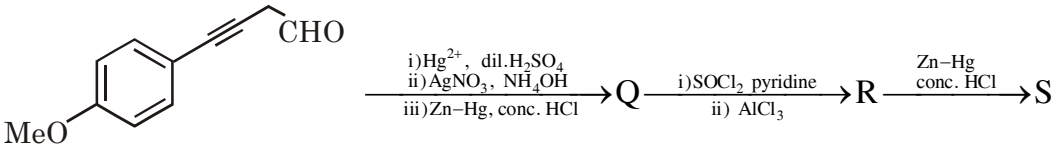
Sol. 1. Natural rubber is polyisoprene containing cis alkene units

2. Nylon-6 has amide linkage $+HN-(CH_2)_5-C+_n$ (O)

3. Cellulose has only β-D glucose units.

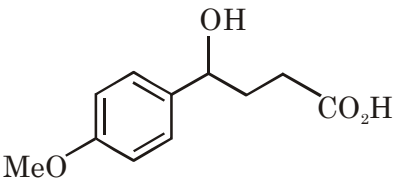
4. $F_2C = CF_2 \xrightarrow{\text{Per sulphate}} +CF_2-CF_2+_n$

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

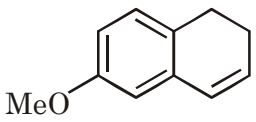


Consider Q, R and S as major products

(1)

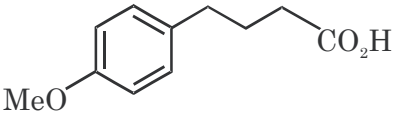


Q

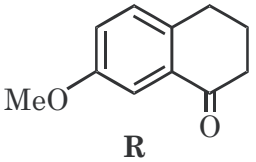


S

(2)

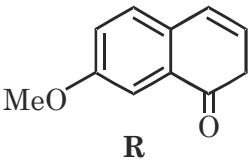


Q

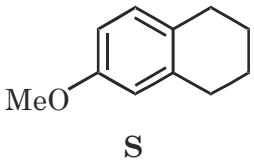


R

(3)

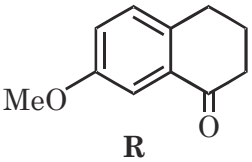


R

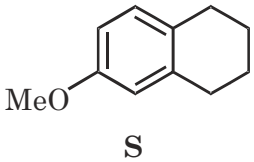


S

(4)



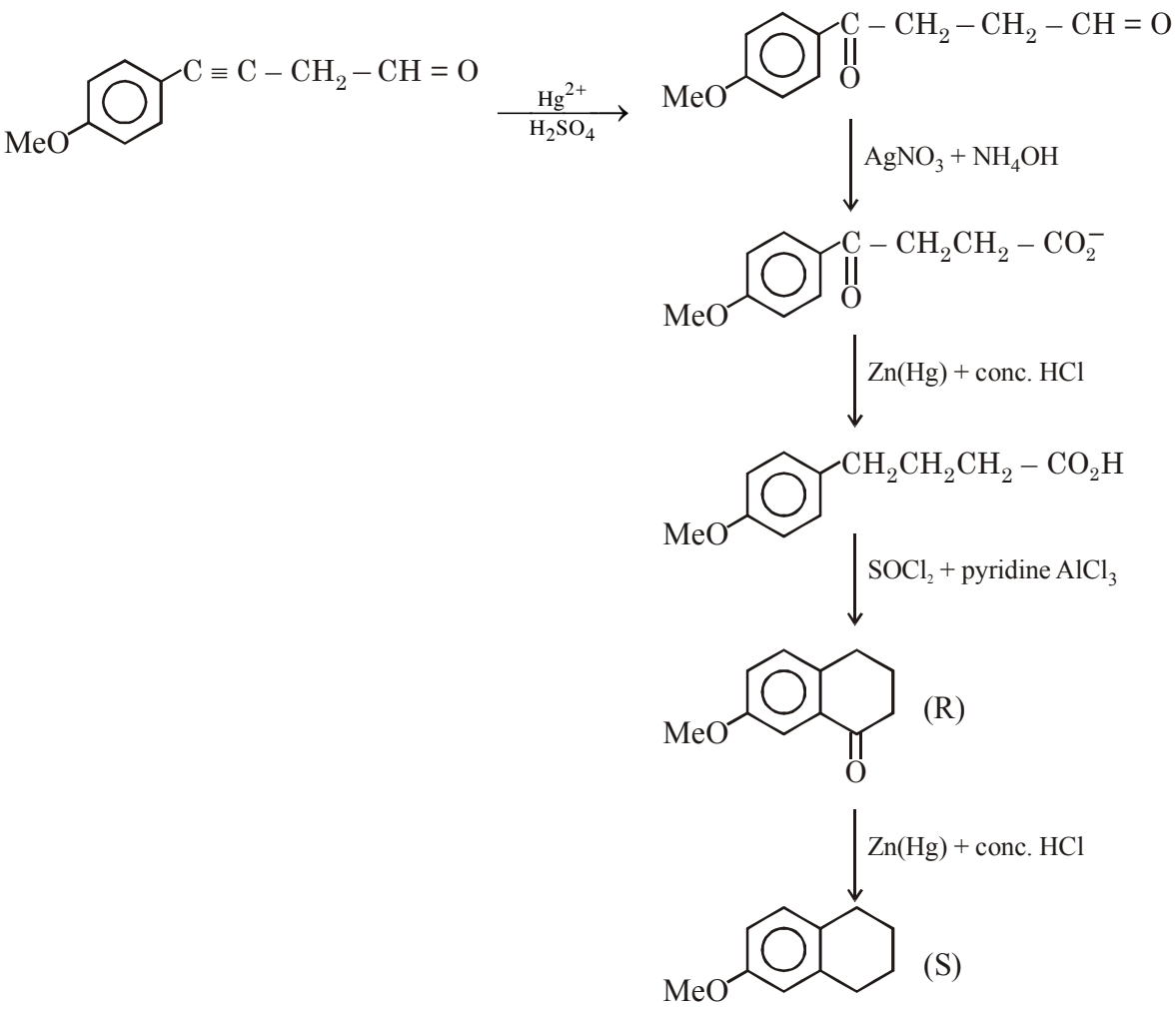
R



S

Ans. (2,4)

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 of the answer 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 to **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.

  Zero Marks : 0 In all other cases.

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1. 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 $Y \times 10^3$ 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 behavior, the value of Y is ___

Ans. (2.30)

Sol. $2N_2O_5(g) \xrightarrow{\Delta} 2N_2O_4(g) + O_2(g)$ at constant V, T

t = 0	1		
t = y × 10^3 sec	(1 − 2P)	2P	P

$P_T = (1 + P) = 1.45$

$P = 0.45$ atm

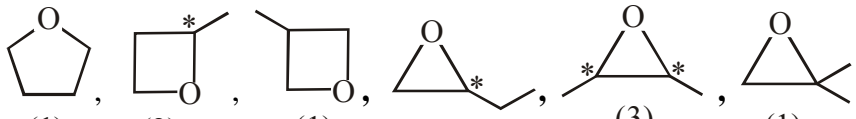
$$(2K)t = 2.303\log\left(\frac{1}{1-2P}\right)$$

$$(2 \times 5 \times 10^{-4}) \times y \times 10^3 = 2.303\log\frac{1}{0.1}$$

$y = 2.303 = 2.30$

2. Total number of isomers, considering both structural and stereoisomers, of cyclic ethers with the molecular formula C_4H_8O is ___

Ans. (10.00)

Sol. 

(1), (2) (R + S), (1), (2) (R + S), (3) R,R R,S S,S, (1)

3. 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. (288.00)

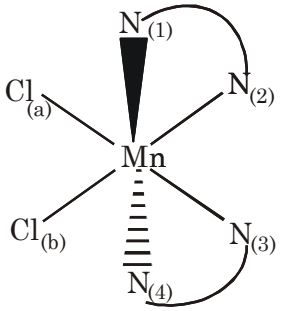
Sol. $S_8 + 48\ HNO_3 \longrightarrow 8H_2SO_4 + 48NO_2 + 16H_2O$

1 mole of rhombic sulphur produce 16 mole of H_2O i.e. 288 gm of H_2O

4. 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. (6.00)

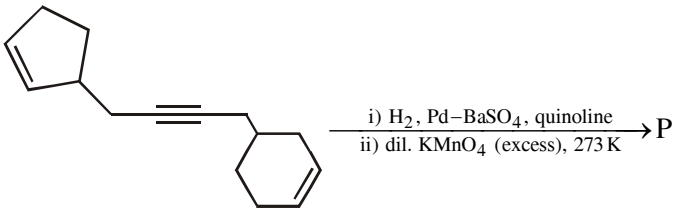
Sol. $cis[M(en)_2Cl_2]$



$Cl_{(a)}$ — Mn — $N_{(1)}$
$Cl_{(a)}$ — Mn — $N_{(2)}$
$Cl_{(a)}$ — Mn — $N_{(4)}$
$Cl_{(b)}$ — Mn — $N_{(1)}$
$Cl_{(b)}$ — Mn — $N_{(3)}$
$Cl_{(b)}$ — Mn — $N_{(4)}$

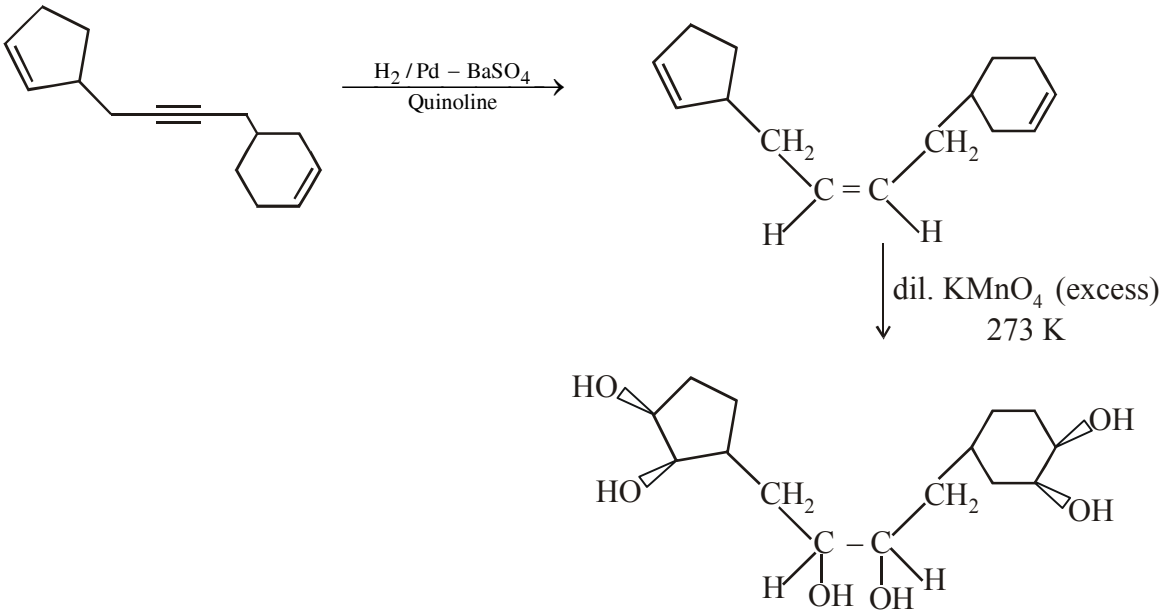
Number of cis (Cl—Mn—N) = 6

5. Total number of hydroxyl groups present in a molecule of the major product P is ___



Ans. (6.00)

Sol.



total 6 –OH group present in a molecule of the major product.

6. 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 or 2.99)

Sol. $X_{urea} = 0.05 = \frac{n}{n+50}$

$19n = 50$

$n = 2.6315$

$V_{sol} = \frac{(2.6315 \times 60 + 900)}{1.2} = 881.5789$ ml

Molarity $= \frac{2.6315 \times 1000}{881.5789} = 2.9849$

Molarity = 2.98M

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.
- Answer to each question will be evaluated according to the following marking scheme :

Full Marks : +3 If ONLY 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

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

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) $\propto n^{1/2}$

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

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

Ans. (3)

Sol. $r = 0.529 \times \frac{n^2}{z} \quad \Rightarrow r \propto n^2 \quad \Rightarrow$ (I) (T)

$mvr = \frac{nh}{2\pi} \quad \Rightarrow (mvr) \propto n \quad \Rightarrow$ (II) (S)

$KE = +13.6 \times \frac{z^2}{n^2} \quad \Rightarrow KE \propto n^{-2} \quad \Rightarrow$ (III) (P)

$PE = -2 \times 13.6 \times \frac{z^2}{n^2} \Rightarrow PE \propto n^{-2} \quad \Rightarrow$ (IV) (P)

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

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) $\propto n^{1/2}$

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

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

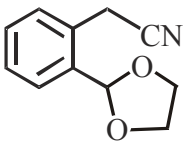
Ans. (4)

Sol. Same as 1 (Section-3)

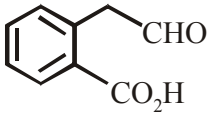
3. Answer the following by appropriately matching the lists based on the information given in the paragraph

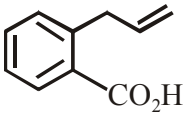
List-I includess starting materials and reagents of selected chemical reactions. List-II gives structures of compounds that may be formed as intermediate products and/or final products from the reactions of List-I

List-I **List-II**

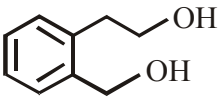
(I) 

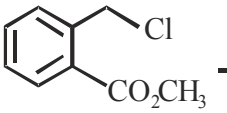
i) DlBAL-H
ii) dil, HCl
iii) $NaBH_4$
iv) conc. H_2SO_4

(P) 

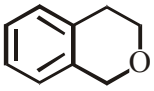
(II) 

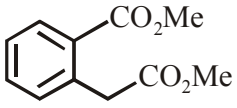
i) O_3
ii) Zn, H_2O
iii) $NaBH_4$
iv) conc. H_2SO_4

(Q) 

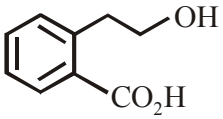
(III) 

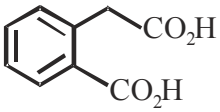
i) KCN
ii) H_3O^+, Δ
iii) $LiAlH_4$
iv) conc. H_2SO_4

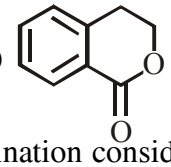
(R) 

(IV) 

i) $LiAlH_4$
ii) conc. H_2SO_4

(S) 

(T) 

(U) 

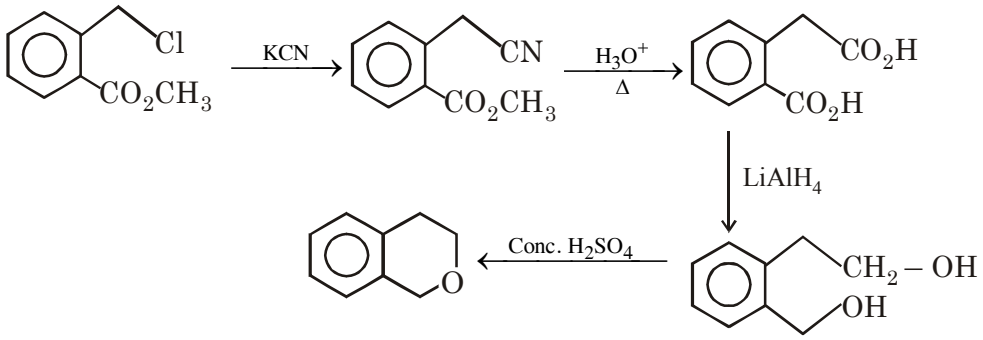
Which of the following options has correct combination considering List-I and List-II?

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

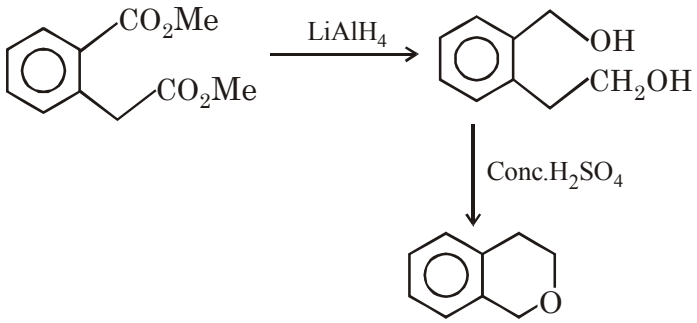
(3) (III), (T), (U) (4) (IV), (Q), (U)

Ans. (2)

Sol.



III, T, Q, R

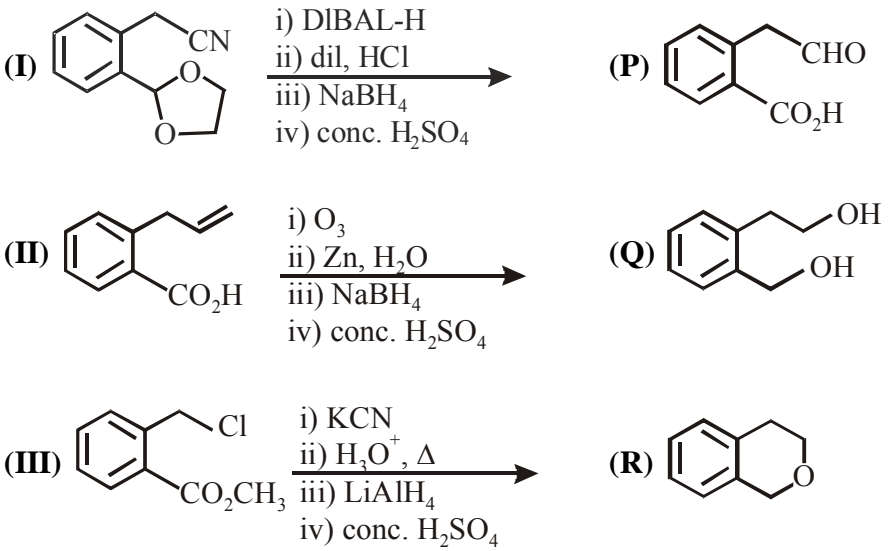


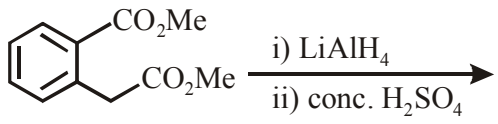
IV, Q, R

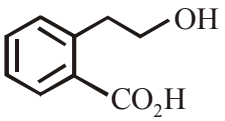
4. Answer the following by appropriately matching the lists based on the information given in the paragraph

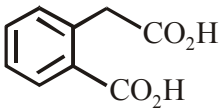
List-I includess starting materials and reagents of selected chemical reactions. List-II gives structures of compounds that may be formed as intermediate products and/or final products from the reactions of List-I

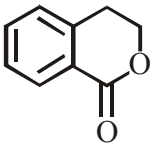
List-I **List-II**



(IV) 

(S) 

(T) 

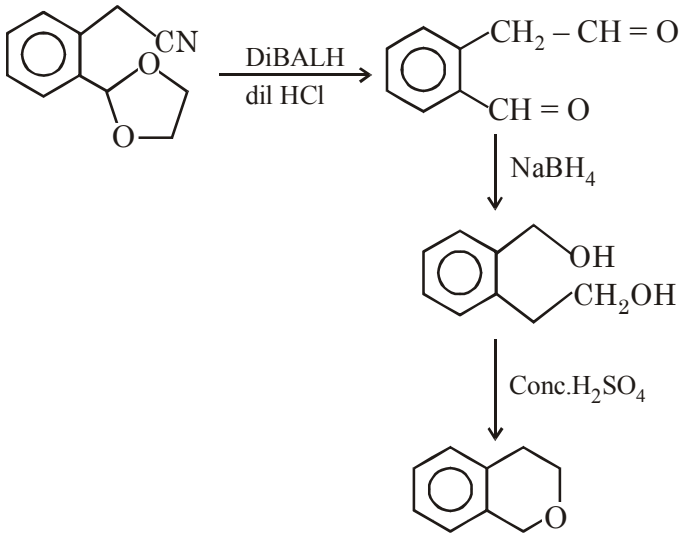
(U) 

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

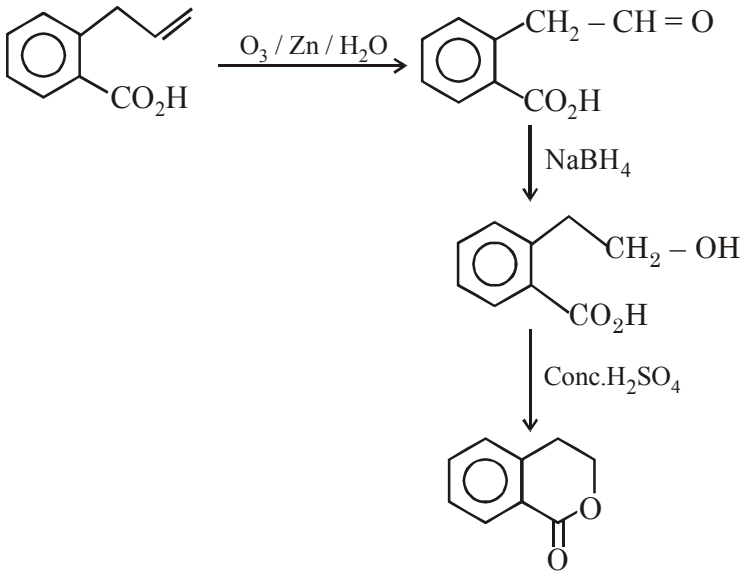
(1) (I), (Q), (T), (U) (2) (II), (P), (S), (U)

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

Ans. (2)

Sol. 

I, Q, R



II, P, S, U