

FINAL JEE(Advanced) EXAMINATION - 2019

(Held On Monday 27th MAY, 2019)

PAPER-2

TEST PAPER WITH ANSWER & SOLUTION

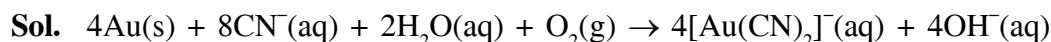
PART-2 : CHEMISTRY

SECTION-1 : (Maximum Marks: 32)

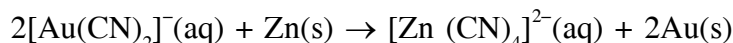
- This section contains **EIGHT (08)** questions.
- Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s)
- Answer to each question will be evaluated according 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.

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 $[\text{Au}(\text{CN})_4]^-$
 (3) **Z** is $[\text{Zn}(\text{CN})_4]^{2-}$
 (4) **Q** is O_2

Ans. (1,3,4)



(Q)

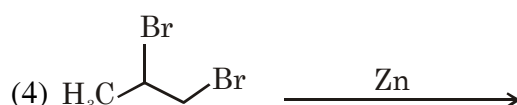
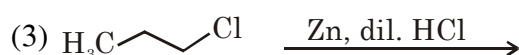
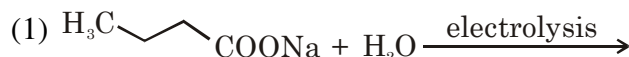


(R)

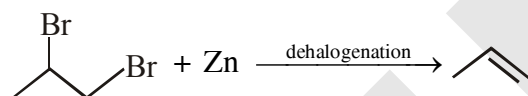
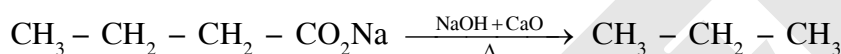
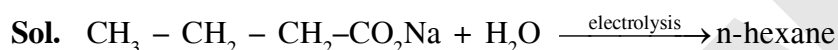
(T)

(Z)

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



Ans. (2,3)



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

$n = 4$

$\ell = 2$

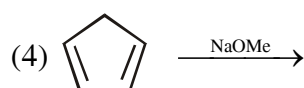
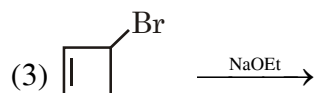
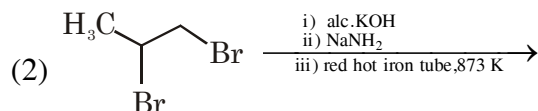
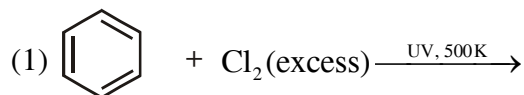
$m = 0$

Angular nodes = $\ell = 2$

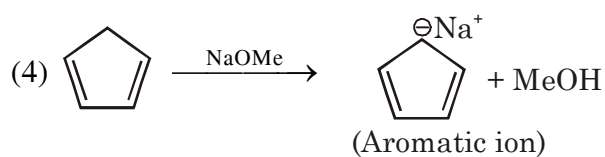
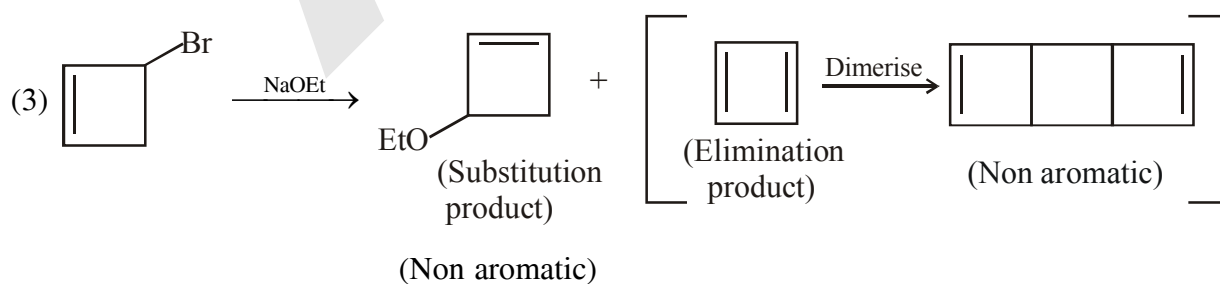
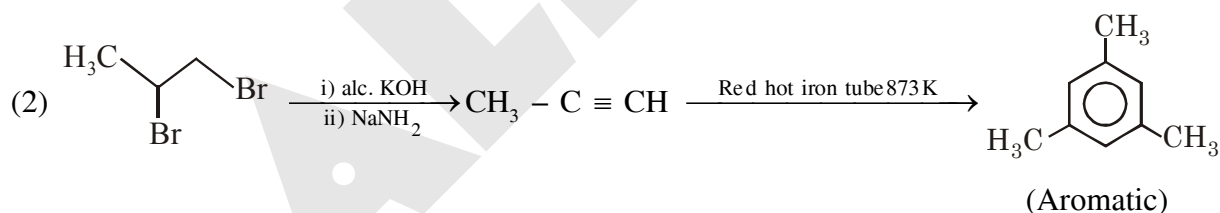
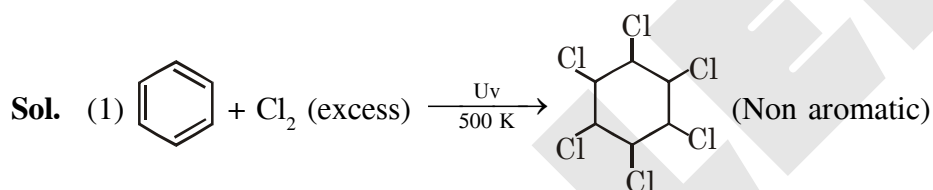
Radial nodes = $(n - \ell - 1) = 1$

$n \ell = 4d$ state

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



Ans. (2,4)



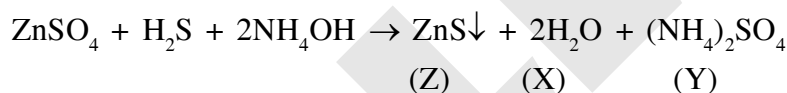
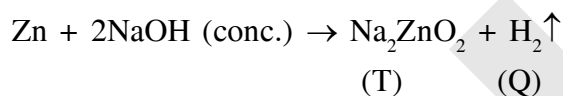
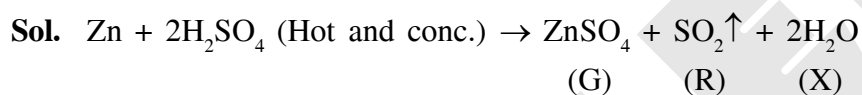
5. Consider the following reactions (unbalanced)



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

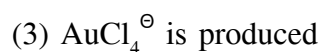
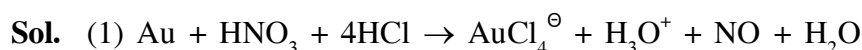
Ans. (2,3,4)



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)



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

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

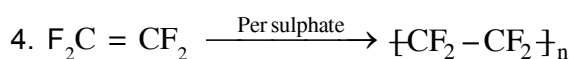
- (1) Natural rubber is polyisoprene containing *trans* alkene units
- (2) Nylon-6 has amide linkages
- (3) Cellulose has only α -D-glucose units that are joined by glycosidic linkages
- (4) Teflon prepared by heating tetrafluoroethene in presence of a persulphate catalyst at high pressure

Ans. (2,4)

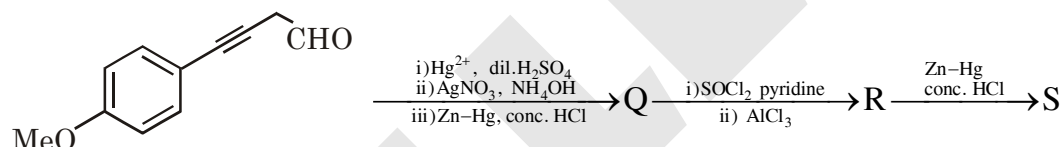
Sol. 1. Natural rubber is polyisoprene containing *cis* alkene units



3. Cellulose has only β -D glucose units.



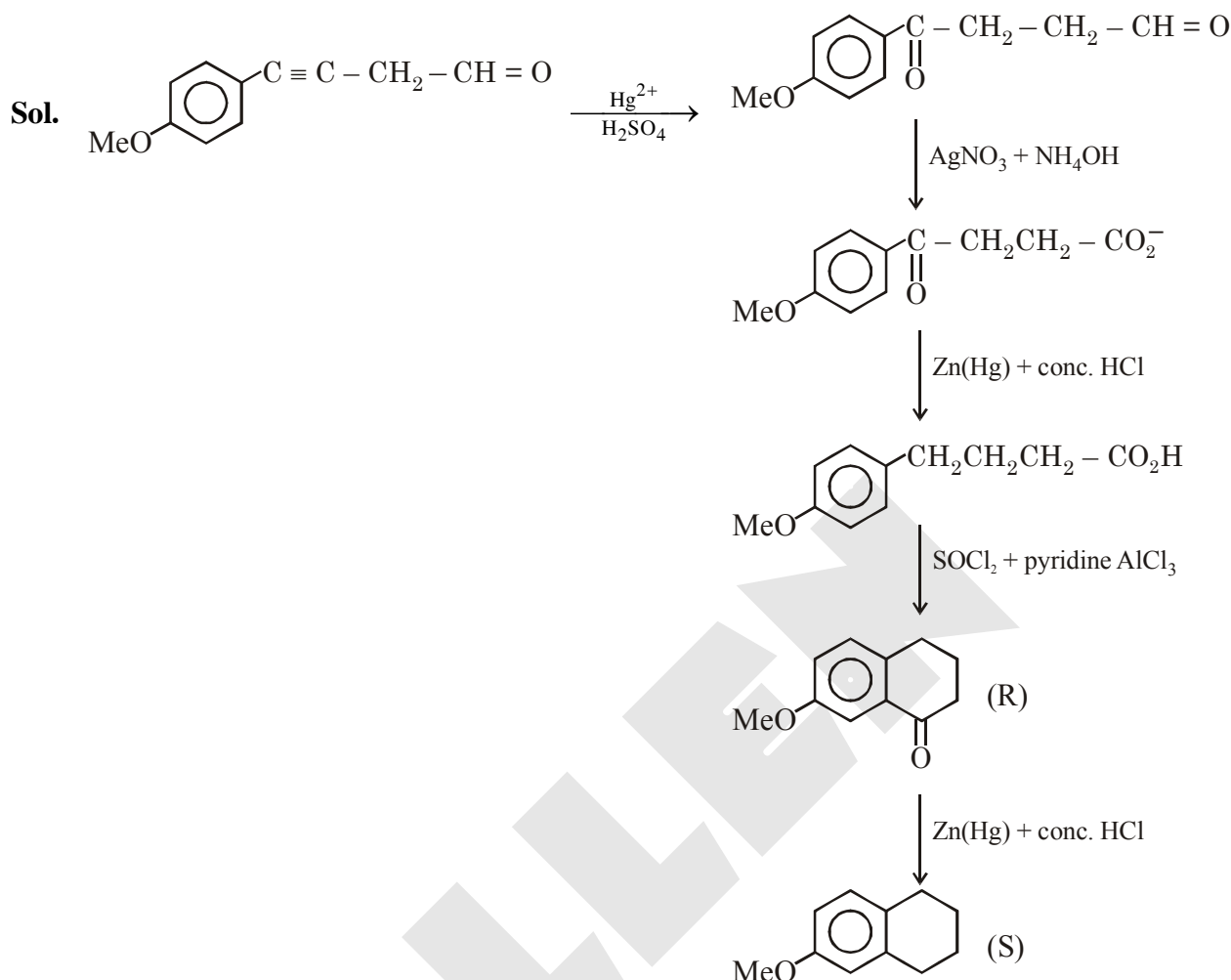
8. Choose the correct option(s) for the following reaction sequence



Consider Q, R and S as major products

- | | |
|--|---|
| <p>(1) <chem>COc1ccc(C(O)CCC(=O)O)cc1</chem></p> <p style="text-align: center;">Q</p> | <p><chem>COc1ccc2ccccc2c1</chem></p> <p style="text-align: center;">S</p> |
| <p>(2) <chem>COc1ccc(CCCC(=O)O)cc1</chem></p> <p style="text-align: center;">Q</p> | <p><chem>COc1ccc2ccccc2C(=O)c1</chem></p> <p style="text-align: center;">R</p> |
| <p>(3) <chem>COc1ccc2ccccc2C(=O)c1</chem></p> <p style="text-align: center;">R</p> | <p><chem>COc1ccc2ccccc2c1</chem></p> <p style="text-align: center;">S</p> |
| <p>(4) <chem>COc1ccc2ccccc2C(=O)c1</chem></p> <p style="text-align: center;">R</p> | <p><chem>COc1ccc2ccccc2c1</chem></p> <p style="text-align: center;">S</p> |

Ans. (2,4)



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.

- The decomposition reaction $2\text{N}_2\text{O}_5(\text{g}) \xrightarrow{\Delta} 2\text{N}_2\text{O}_4(\text{g}) + \text{O}_2(\text{g})$ 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 $5 \times 10^{-4} \text{ s}^{-1}$, assuming ideal gas behavior, the value of Y is ____

Ans. (2.30)

Sol. $2\text{N}_2\text{O}_5(\text{g}) \xrightarrow{\Delta} 2\text{N}_2\text{O}_4(\text{g}) + \text{O}_2(\text{g})$ at constant V, T

$$t = 0 \quad 1$$

$$t = y \times 10^3 \text{ sec} \quad (1 - 2P) \quad 2P \quad P$$

$$P_T = (1 + P) = 1.45$$

$$P = 0.45 \text{ atm}$$

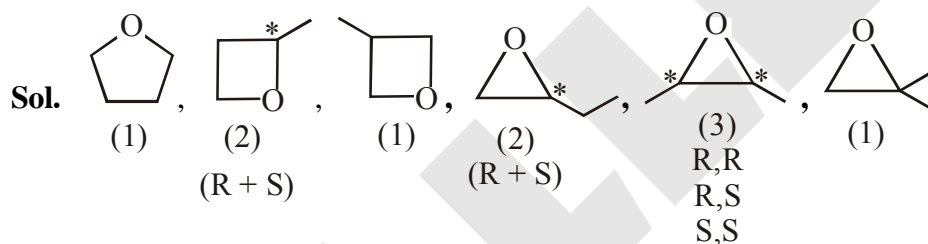
$$(2K)t = 2.303 \log \left(\frac{1}{1-2P} \right)$$

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

$$y = 2.303 = 2.30$$

2. Total number of isomers, considering both structural and stereoisomers, of cyclic ethers with the molecular formula $\text{C}_4\text{H}_8\text{O}$ is ____

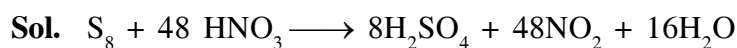
Ans. (10.00)



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)

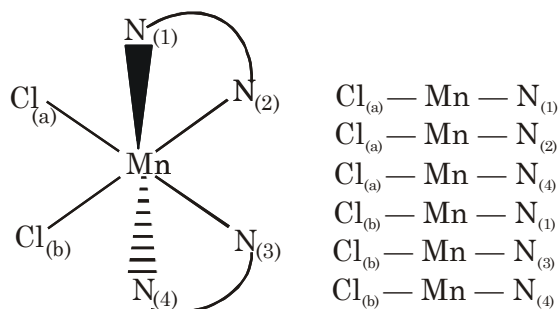


1 mole of rhombic sulphur produce 16 mole of H_2O i.e. 288 gm of H_2O

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)₂Cl₂] complex is ____ (en = NH₂CH₂CH₂NH₂)

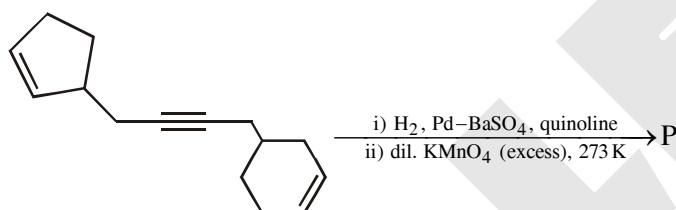
Ans. (6.00)

Sol. *cis*[M(en)₂Cl₂]

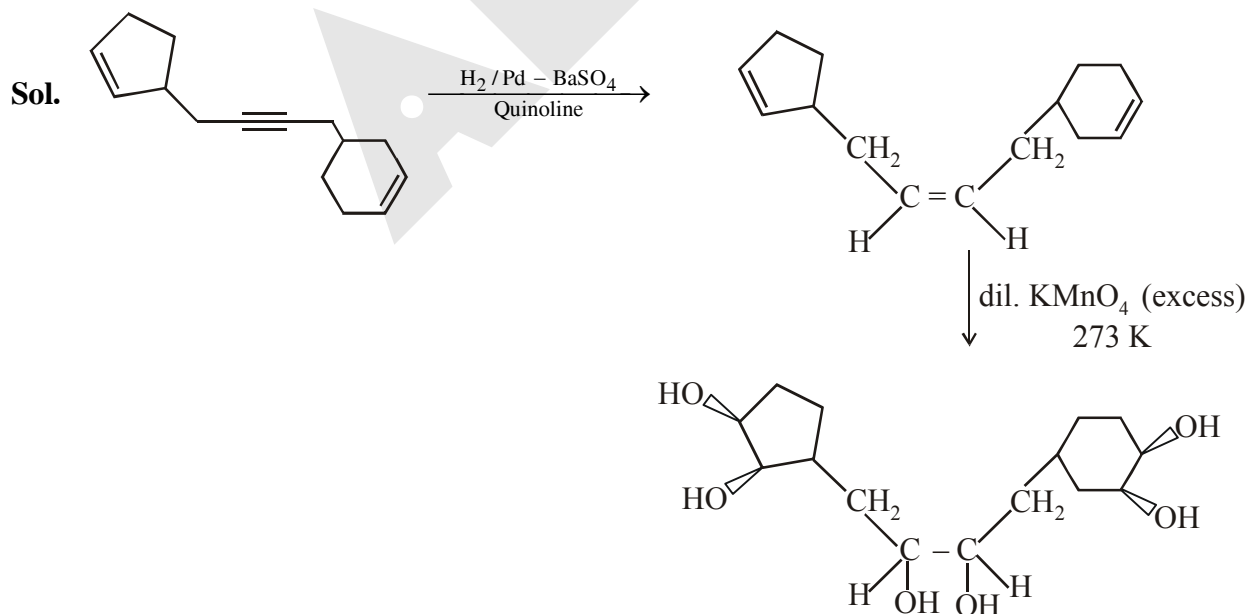


Number of *cis* (Cl—Mn—N) = 6

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



Ans. (6.00)



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)

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

$$19n = 50$$

$$n = 2.6315$$

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

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

$$\text{Molarity} = 2.98\text{M}$$

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

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. $r = 0.529 \times \frac{n^2}{Z} \Rightarrow r \propto n^2 \Rightarrow \text{(I) (T)}$

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

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

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

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

- (I) Radius of the n^{th} orbit
- (II) Angular momentum of the electron in the n^{th} orbit
- (III) Kinetic energy of the electron in the n^{th} orbit
- (IV) Potential energy of the electron in the n^{th} orbit

List-II

- (P) $\propto n^{-2}$
- (Q) $\propto n^{-1}$
- (R) $\propto n^0$
- (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)

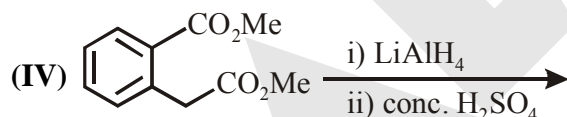
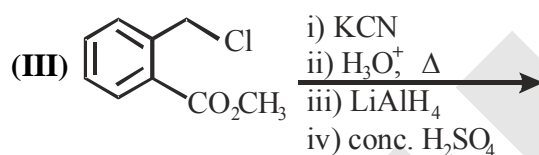
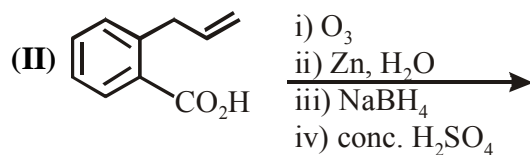
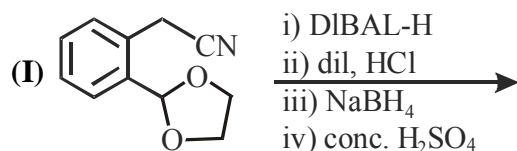
Ans. (4)

Sol. Same as 1 (Section-3)

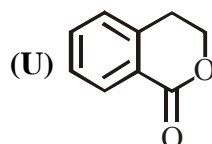
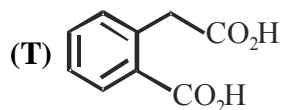
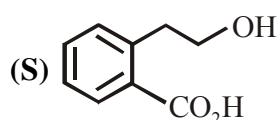
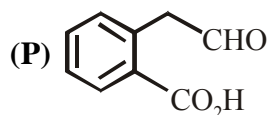
3. Answer the following by appropriately matching the lists based on the information given in the paragraph

List-I 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



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

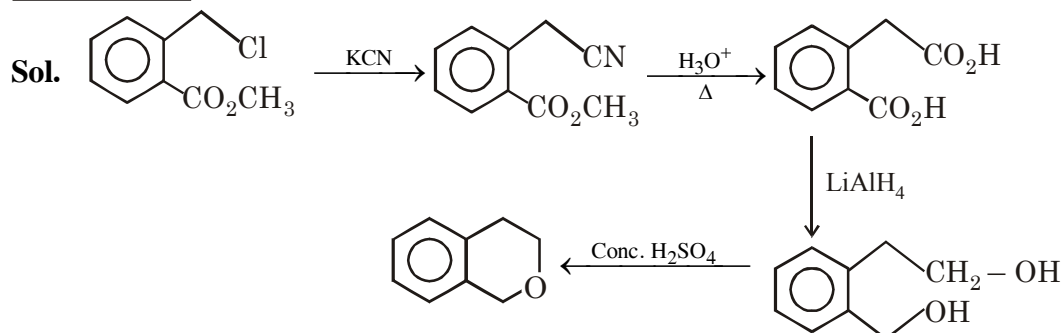
(1) (III), (S), (R)

(2) (IV), (Q), (R)

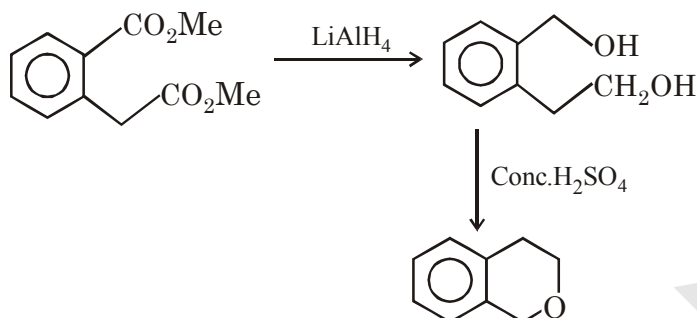
(3) (III), (T), (U)

(4) (IV), (Q), (U)

Ans. (2)



III, T, Q, R

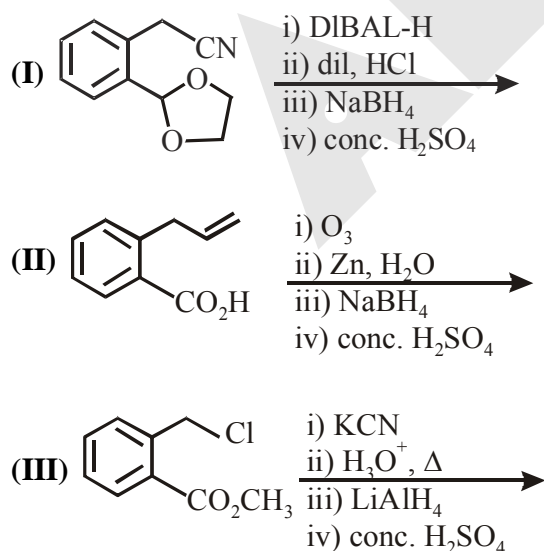


IV, Q, R

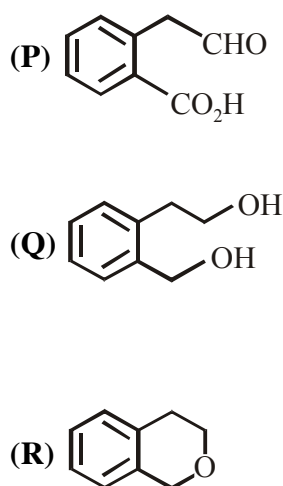
4. Answer the following by appropriately matching the lists based on the information given in the paragraph

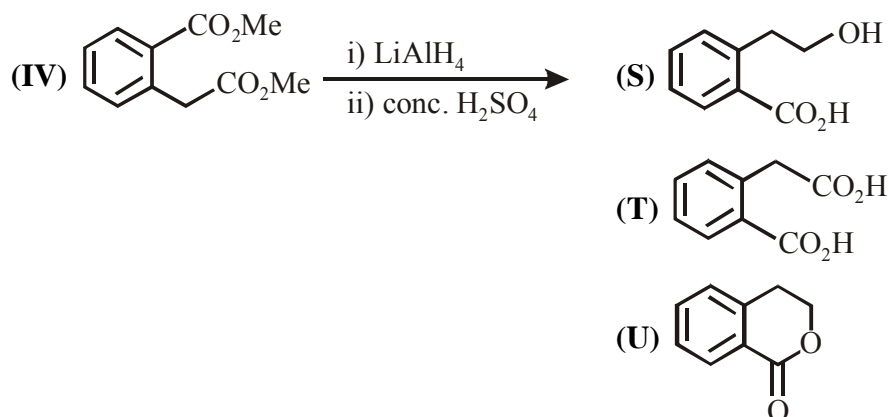
List-I includes starting materials and reagents of selected chemical reactions. List-II gives structures of compounds that may be formed as intermediate products and/or final products from the reactions of List-I

List-I



List-II





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

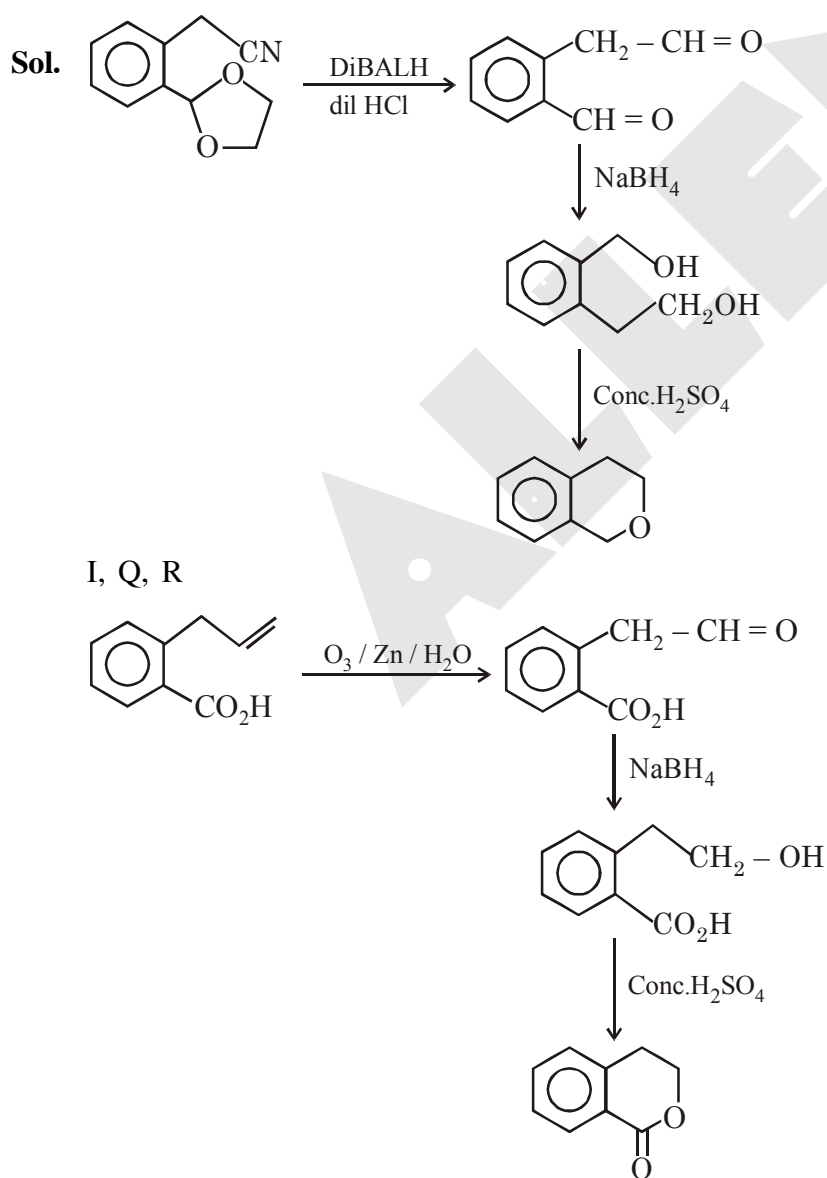
(1) (I), (Q), (T), (U)

(2) (II), (P), (S), (U)

(3) (II), (P), (S), (T)

(4) (I), (S), (Q), (R)

Ans. (2)



II, P, S, U