JEE ADVANCED (Paper - 2)

Code - 8

CHEMISTRY

SECTION – 1 : (Only One Option Correct Type)

This section contains 10 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

*21. Assuming *2s – 2p* mixing is **NOT** operative, the paramagnetic species among the following is
(A) Be_2 (B) B_2
(C) C_2 (D) N_2

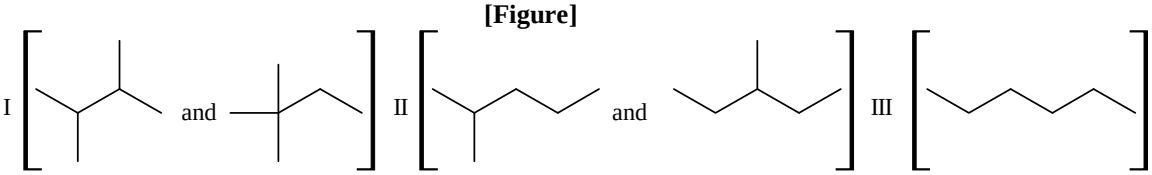
*22. For the process
$H_2O(\ell) \longrightarrow H_2O(g)$
at T = 100°C and 1 atmosphere pressure, the correct choice is
(A) $\Delta S_{system} > 0$ and $\Delta S_{surrounding} > 0$ (B) $\Delta S_{system} > 0$ and $\Delta S_{surrounding} < 0$
(C) $\Delta S_{system} < 0$ and $\Delta S_{surrounding} > 0$ (D) $\Delta S_{system} < 0$ and $\Delta S_{surrounding} < 0$

*23. For the elementary reaction **M** $\rightarrow$ **N**, the rate of disappearance of **M** increases by a factor of 8 upon doubling the concentration of **M**. The order of the reaction with respect to **M** is
(A) 4 (B) 3
(C) 2 (D) 1

24. For the identification of β-naphthol using dye test, it is necessary to use
(A) dichloromethane solution of β-naphthol. (B) acidic solution of β-naphthol.
(C) neutral solution of β-naphthol. (D) alkaline solution of β-naphthol.

*25. Isomers of hexane, based on their branching, can be divided into three distinct classes as shown in the figure.

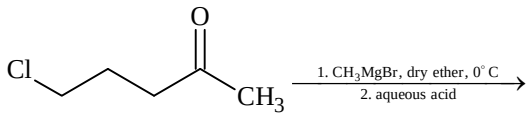
[Figure]

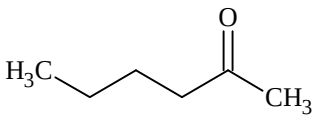


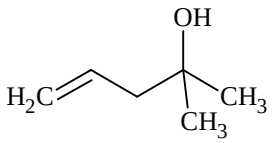
The correct order of their boiling point is
(A) I > II > III (B) III > II > I
(C) II > III > I (D) III > I > II

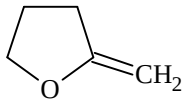
26. The major product in the following reaction is

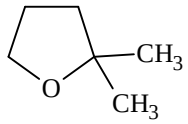
[Figure]



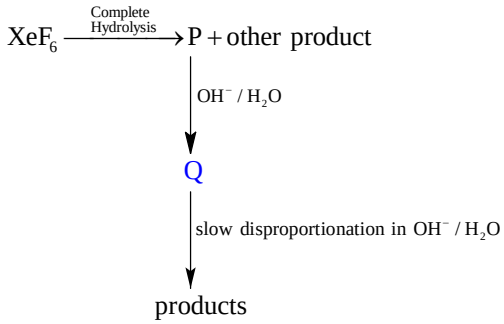
(A)


(B)


(C)


(D)


27. Under ambient conditions, the total number of gases released as products in the final step of the reaction scheme shown below is



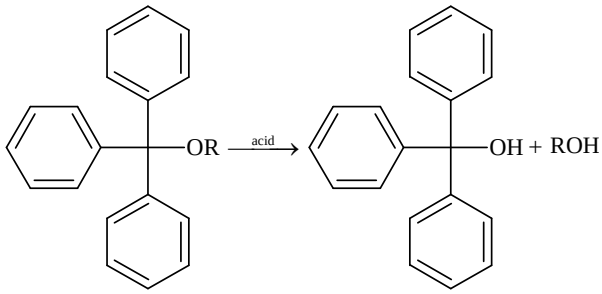
(A) 0 (B) 1
(C) 2 (D) 3

28. The product formed in the reaction of $SOCl_2$ with white phosphorous is
(A) PCl_3 (B) SO_2Cl_2
(C) SCl_2 (D) $POCl_3$

*29. Hydrogen peroxide in its reaction with KIO_4 and NH_2OH respectively, is acting as a
(A) reducing agent, oxidising agent (B) reducing agent, reducing agent
(C) oxidising agent, oxidising agent (D) oxidising agent, reducing agent

30. The acidic hydrolysis of ether (X) shown below is fastest when

[Figure]



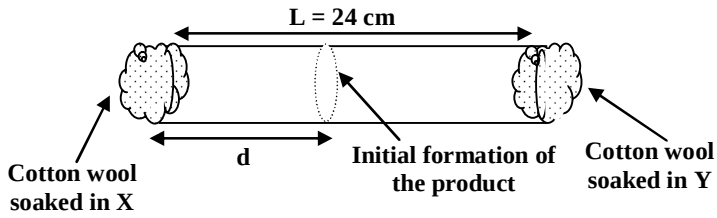
(A) one phenyl group is replaced by a methyl group.
(B) one phenyl group is replaced by a para-methoxyphenyl group.
(C) two phenyl groups are replaced by two para-methoxyphenyl groups.
(D) no structural change is made to **X**.

SECTION – 2 : Comprehension type (Only One Option Correct)

This section contains 3 paragraphs, each describing theory, experiments, data etc. Six questions relate to the three paragraphs with two questions on each paragraph. Each question has only one correct answer among the four given options (A), (B), (C) and (D).

Paragraph for Questions 31 & 32

X and Y are two volatile liquids with molar weights of 10 g mol^{-1} and 40 g mol^{-1} respectively. Two cotton plugs, one soaked in X and the other soaked in Y, are simultaneously placed at the ends of a tube of length L = 24 cm, as shown in the figure. The tube is filled with an inert gas at 1 atmosphere pressure and a temperature of 300 K. Vapours of X and Y react to form a product which is first observed at a distance d cm from the plug soaked in X. Take X and Y to have equal molecular diameters and assume ideal behaviour for the inert gas and the two vapours.

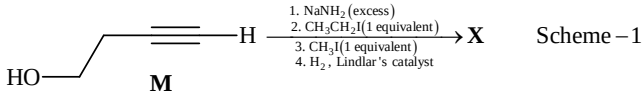


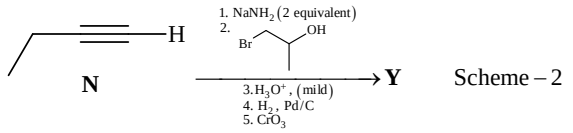
*31. The value of d in cm (shown in the figure), as estimated from Graham's law, is
(A) 8 (B) 12
(C) 16 (D) 20

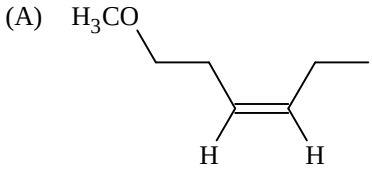
*32. The experimental value of d is found to be smaller than the estimate obtained using Graham's law. This is due to
(A) larger mean free path for **X** as compared to that of **Y**.
(B) larger mean free path for **Y** as compared to that of **X**.
(C) increased collision frequency of **Y** with the inert gas as compared to that of **X** with the inert gas.
(D) increased collision frequency of **X** with the inert gas as compared to that of **Y** with the inert gas.

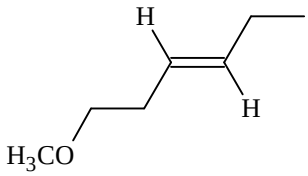
Paragraph for Questions 33 & 34

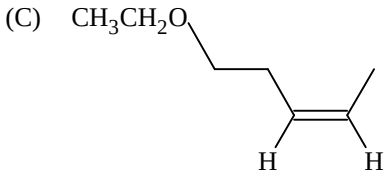
Schemes 1 and 2 describe sequential transformation of alkynes M and N. Consider only the major products formed in each step for both schemes.

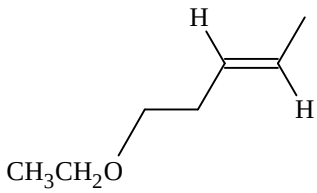




33. The product **X** is
(A) 

(B) 

(C) 

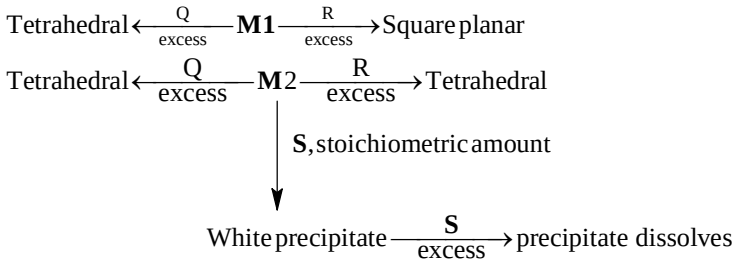
(D) 

34. The correct statement with respect to product **Y** is
(A) It gives a positive Tollens test and is a functional isomer of **X**.
(B) It gives a positive Tollens test and is a geometrical isomer of **X**.
(C) It gives a positive iodoform test and is a functional isomer of **X**.
(D) It gives a positive iodoform test and is a geometrical isomer of **X**.

Paragraph for Questions 35 & 36

An aqueous solution of metal ion **M1** reacts separately with reagents **Q** and **R** in excess to give tetrahedral and square planar complexes, respectively. An aqueous solution of another metal ion **M2** always forms tetrahedral complexes with these reagents. Aqueous solution of **M2** on reaction with reagent S gives white precipitate which dissolves in excess of S. The reactions are summarized in the scheme given below.

SCHEME:



35. **M1**, **Q** and **R**, respectively are

(A) Zn^{2+}, KCN and HCl (B) Ni^{2+}, HCl and KCN

(C) Cd^{2+}, KCN and HCl (D) Co^{2+}, HCl and KCN

36. Reagent S is

(A) $K_4\left[Fe(CN)_6\right]$ (B) Na_2HPO_4

(C) K_2CrO_4 (D) KOH

SECTION – 3: Match List Type (Only One Option Correct)

This section contains four questions, each having two matching lists. Choices for the correct combination of elements from List-I and List-II are given as option (A), (B), (C) and (D) out of which one is correct.

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37. Match each coordination compound in **List-I** with an appropriate pair of characteristics from **List-II** and select the correct answer using the code given below the lists

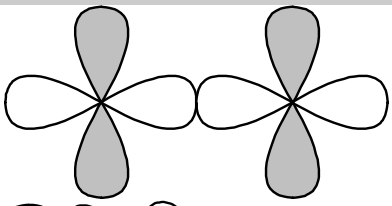
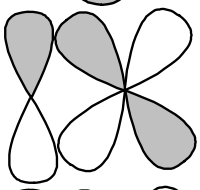
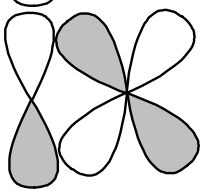
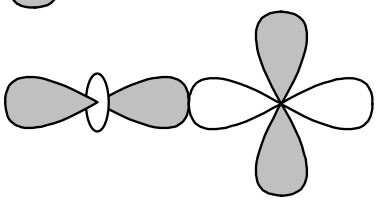
{en = $H_2NCH_2CH_2NH_2$; atomic numbers: Ti = 22, Cr = 24; Co= 27; Pt = 78)

List – I		List - II	
P.	$[Cr(NH_3)_4Cl_2]Cl$	**1.**	Paramagnetic and exhibits ionization isomerism
Q.	$[Ti(H_2O)_5Cl](NO_3)_2$	**2.**	Diamagnetic and exhibits *cis-trans* isomerism
R.	$[Pt(en)(NH_3)Cl]NO_3$	**3.**	Paramagnetic and exhibits *cis-trans* isomerism
S.	$[Co(NH_3)_4(NO_3)_2]NO_3$	**4.**	Diamagnetic and exhibits ionization isomerism

Code:

	P	Q	R	S
(A)	4	2	3	1
(B)	3	1	4	2
(C)	2	1	3	4
(D)	1	3	4	2

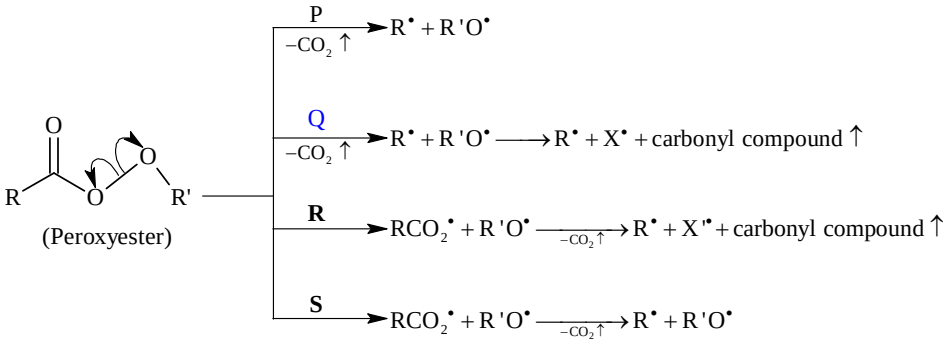
*38. Match the orbital overlap figures shown in **List-I** with the description given in **List-II** and select the correct answer using the code given below the lists.

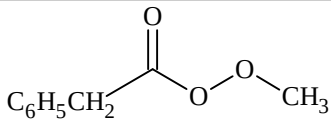
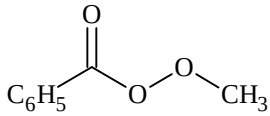
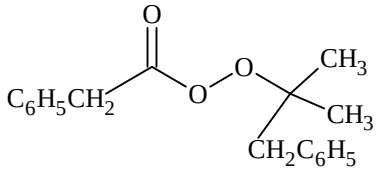
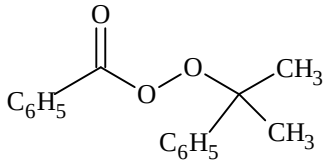
List – I		**List - II**
P.		**1.** $p - d$ π antibonding
Q.		**2.** $d - d$ σ bonding
R.		**3.** $p - d$ π bonding
S.		**4.** $d - d$ σ antibonding

Code:

	P	Q	R	S
(A)	2	1	3	4
(B)	4	3	1	2
(C)	2	3	1	4
(D)	4	1	3	2

39. Different possible **thermal** decomposition pathways for peroxyesters are shown below. Match each pathway from **List I** with an appropriate structure from **List II** and select the correct answer using the code given below the lists.

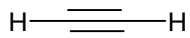
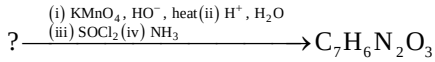
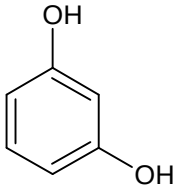
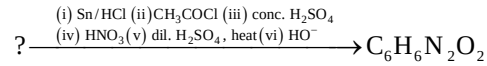
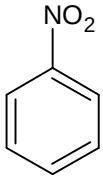
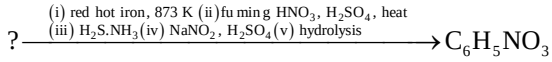
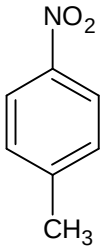
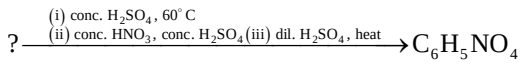


List – I		List – II	
P.	Pathway **P**	**1.**	
Q.	Pathway **Q**	**2.**	
R.	Pathway **R**	**3.**	
S.	Pathway **S**	**4.**	

Code:

	P	Q	R	S
(A)	1	3	4	2
(B)	2	4	3	1
(C)	4	1	2	3
(D)	3	2	1	4

40. Match the four starting materials **(P, Q, R, S)** given in **List I** with the corresponding reaction schemes **(I, II, III, IV)** provided in **List II** and select the correct answer using the code given below the lists.

List – I	**List - II**
P. 	**1.** Scheme I 
Q. 	**2.** Scheme II 
R. 	**3.** Scheme III 
S. 	**4.** Scheme IV 

Code:

	P	Q	R	S
(A)	1	4	2	3
(B)	3	1	4	2
(C)	3	4	2	1
(D)	4	1	3	2

ANSWERS

PAPER-2 [Code – 8]

JEE(ADVANCED) 2014

CHEMISTRY

21.	**C**	22.	**B**	23.	**B**	24.	**D**
25.	**B**	26.	**D**	27.	**C**	28.	**A**
29.	**A**	30.	**C**	31.	**C**	32.	**D**
33.	**A**	34.	**C**	35.	**B**	36.	**D**
37.	**B**	38.	**C**	39.	**A**	40.	**C**

HINTS AND SOLUTIONS

CHEMISTRY

21. Assuming that no 2s-2p mixing takes place

$(A)\ Be_2 \rightarrow\ \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$ (diamagnetic)

$(B)\ B_2 \rightarrow\ \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \begin{matrix}\pi 2p_x^0 \\ \pi 2p_y^0\end{matrix}$ (diamagnetic)

$(C)\ C_2 \rightarrow\ \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \begin{matrix}\pi 2p_x^1 \\ \pi 2p_y^1\end{matrix}, \begin{matrix}\pi^* 2p_x^0 \\ \pi^* 2p_y^0\end{matrix}, \sigma^* 2p_z^0$ (paramagnetic)

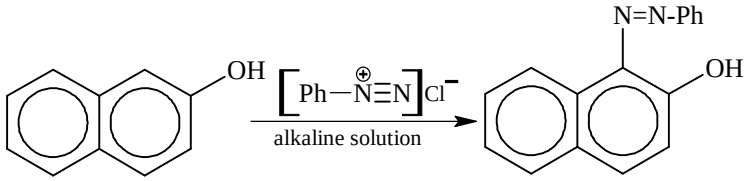
$(D)\ N_2 \rightarrow\ \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \begin{matrix}\pi 2p_x^2 \\ \pi 2p_y^2\end{matrix}, \begin{matrix}\pi^* 2p_x^0 \\ \pi^* 2p_y^0\end{matrix}, \sigma^* 2p_z^0$ (diamagnetic)

22. At 100^0C and 1 atmosphere pressure $H_2O(\ell) \rightleftharpoons H_2O(g)$ is at equilibrium. For equilibrium $\Delta S_{total} = 0$ and $\Delta S_{system} + \Delta S_{surrounding} = 0$

$\therefore \quad \Delta S_{system} > 0 \text{ and } \Delta S_{surrounding} < 0$

23. $\frac{r_1}{r_2} = \frac{1}{8} = \frac{[M]^n}{[2M]^n} \Rightarrow n = 3$

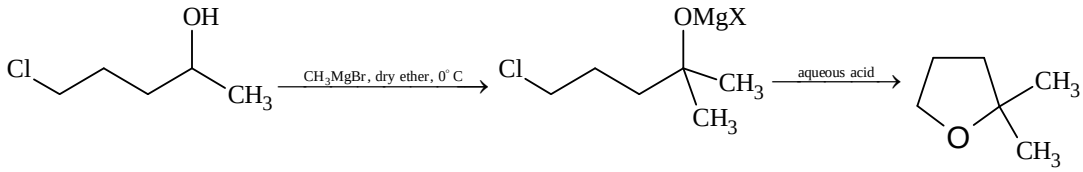
24.



25. III > II > I

More the branching in an alkane, lesser will be the surface area, lesser will be the boiling point.

26.



27. $XeF_6 + 3H_2O \longrightarrow XeO_3 + 3H_2F_2$

$XeO_3 \xrightarrow{OH^-} HXeO_4^-$

$HXeO_4^- \xrightarrow{OH^- / H_2O \text{ (disproportionation)}} XeO_{6\,(s)}^{4-} + Xe_{(g)} + H_2O_{(\ell)} + O_{2(g)}$

28. $P_{4(s)} + 8SOCl_{2(\ell)} \longrightarrow 4PCl_{3(\ell)} + 4SO_{2(g)} + 2S_2Cl_{2(g)}$

29. $KIO_4 + H_2O_2 \longrightarrow KIO_3 + H_2O + O_2$

$NH_2OH + 3H_2O_2 \longrightarrow HNO_3 + 4H_2O$

30. When two phenyl groups are replaced by two para methoxy group, carbocation formed will be more stable

31. $\frac{r_X}{r_Y} = \frac{d}{24-d} = \sqrt{\frac{40}{10}} = 2$

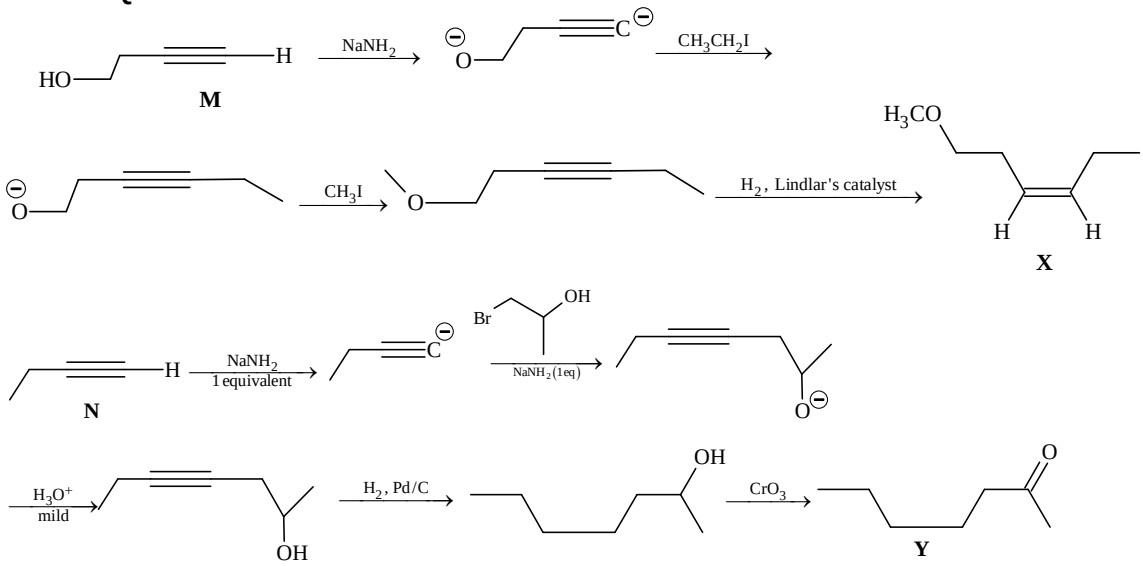
d = 48 – 2d

3d = 48

$d = 16\text{cm}$

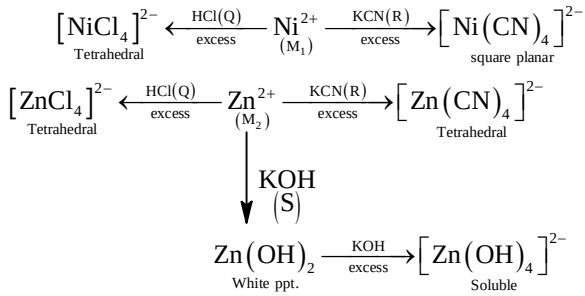
32. As the collision frequency increases then molecular speed decreases than the expected.

Solution for the Q. No. 33 to 34.



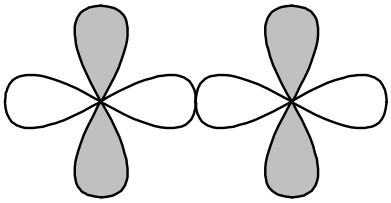
X and Y are functional isomers of each other and Y gives iodoform test.

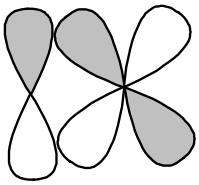
Solution for the Q. No. 35 to 36.

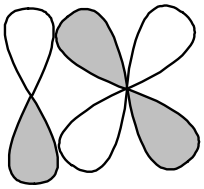


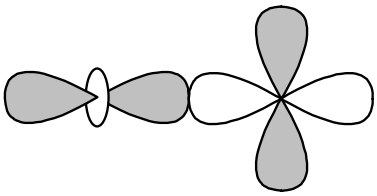
37. (P) $[Cr(NH_3)_4Cl_2]Cl \longrightarrow$ Paramagnetic and exhibits *cis-trans* isomerism
(Q) $[Ti(H_2O)_5Cl](NO_3)_2 \longrightarrow$ Paramagnetic and exhibits ionization isomerism
(R) $[Pt(en)(NH_3)Cl]NO_3 \longrightarrow$ Diamagnetic and exhibits ionization isomerism
(S) $[Co(NH_3)_4(NO_3)_2]NO_3 \longrightarrow$ Diamagnetic and exhibits *cis-trans* isomerism

38.

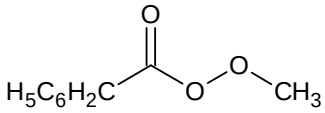
P.  $\longrightarrow$ *d* – *d* σ bonding

Q.  $\longrightarrow$ *p* – *d* π bonding

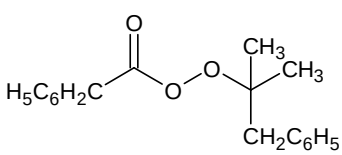
R.  $\longrightarrow$ *p* – *d* π antibonding

S.  $\longrightarrow$ *d* – *d* σ antibonding

39. (P) – 1; (Q) – 3; (R) – 4; (S) – 2

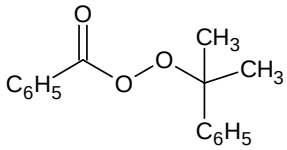
(P) 

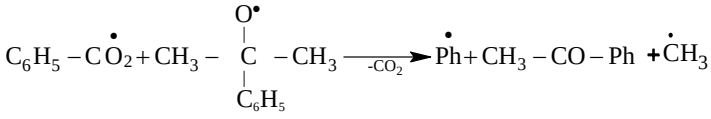
$$C_6H_5-\dot{C}H_2 + CO_2 + CH_3O^{\bullet}$$

(Q) 

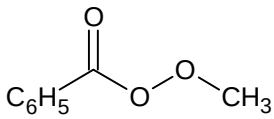
$$C_6H_5-\dot{C}H_2 + CO_2 + Ph-CH_2-\underset{\displaystyle CH_3}{\overset{\displaystyle O^{\bullet}}{\overset{|}{\underset{|}{C}}}}-CH_3 \longrightarrow Ph-\dot{C}H_2 + CH_3-CO-CH_3$$

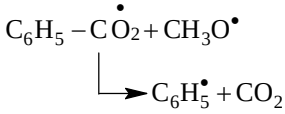
(R)



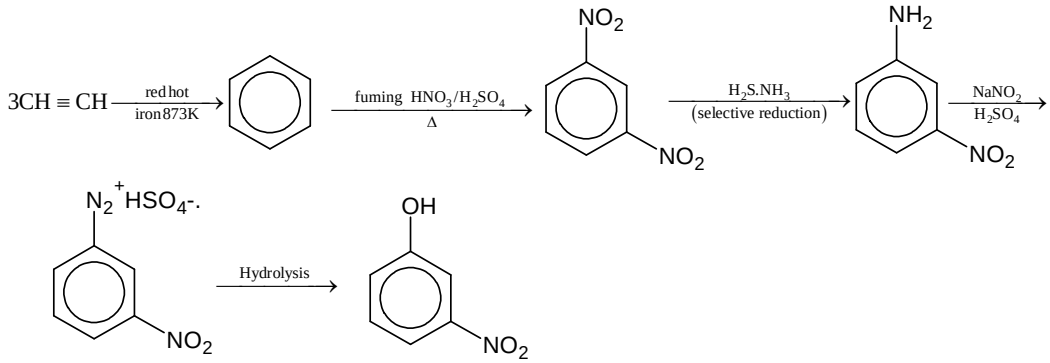


(S)

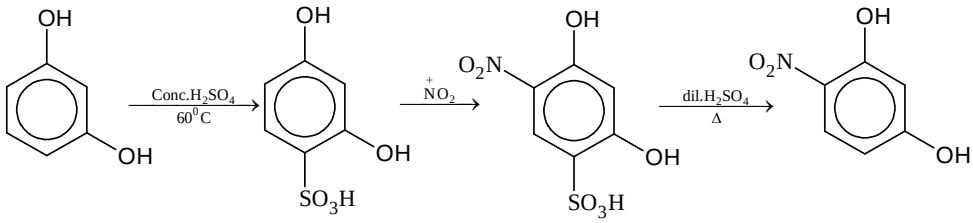




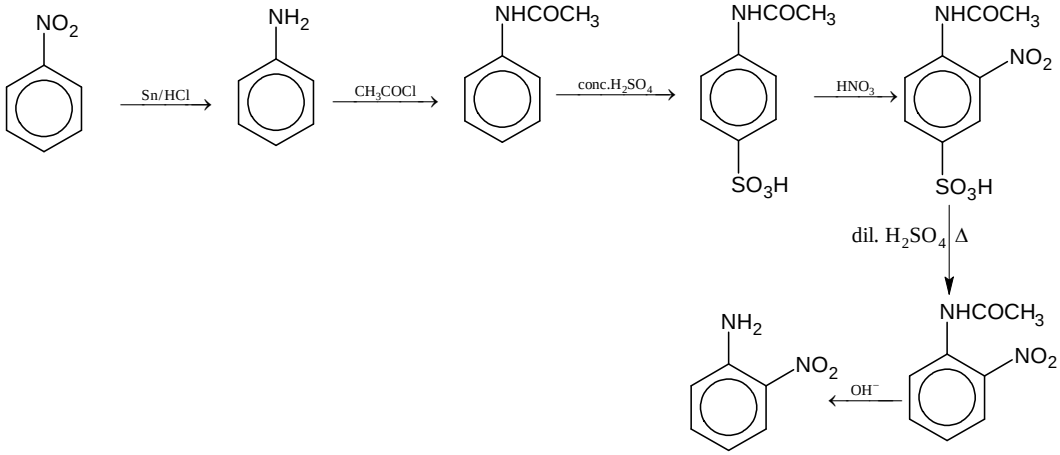
40. (P)



(Q)



(R)



(S)