

JEE(Advanced) – 2017 TEST PAPER WITH SOLUTION

(HELD ON SUNDAY 21st MAY, 2017)

CHEMISTRY

SECTION-1 : (Maximum Marks : 28)

- This section contains **SEVEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- For each question, marks will be awarded in one of the following categories :

Full Marks : +4 If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.

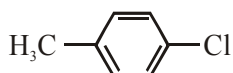
Partial Marks : +1 For darkening a bubble corresponding to **each correct option**, Provided NO incorrect option is darkened.

Zero Marks : 0 If none of the bubbles is darkened.

Negative Marks : -2 In all other cases.

- for example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will get +4 marks; darkening only (A) and (D) will get +2 marks; and darkening (A) and (B) will get -2 marks, as a wrong option is also darkened

19. The IUPAC name(s) of the following compound is(are)



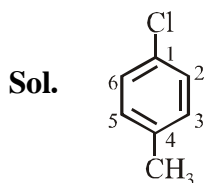
(A) 4-methylchlorobenzene

(B) 4-chlorotoluene

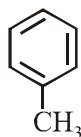
(C) 1-chloro-4-methylbenzene

(D) 1-methyl-4-chlorobenzene

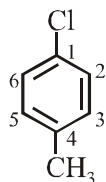
19. **Ans.(B,C)**



1-Chloro-4-methylbenzene

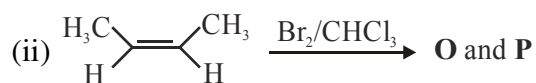
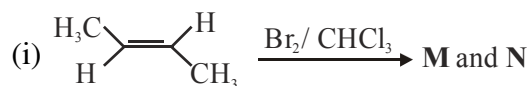


IUPAC Name- "Toluene" is accepted by IUPAC as a name of parent carbon chain.



So it can also be named as 4-chlorotoluene.

20. The correct statement(s) for the following addition reactions is(are)



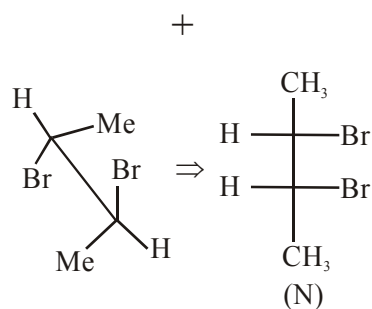
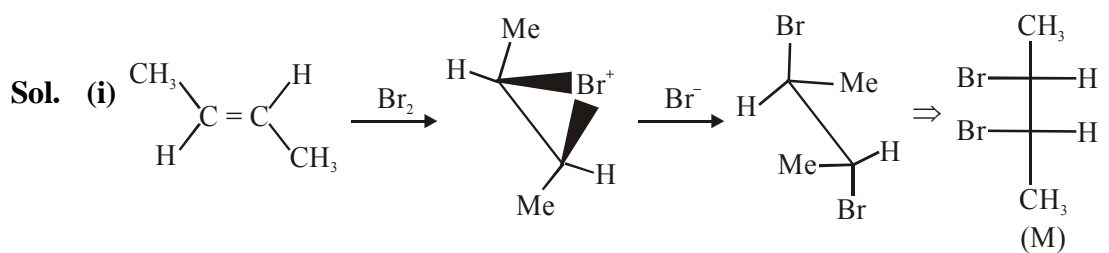
(A) (M and O) and (N and P) are two pairs of diastereomers

(B) Bromination proceeds through *trans*-addition in both the reactions

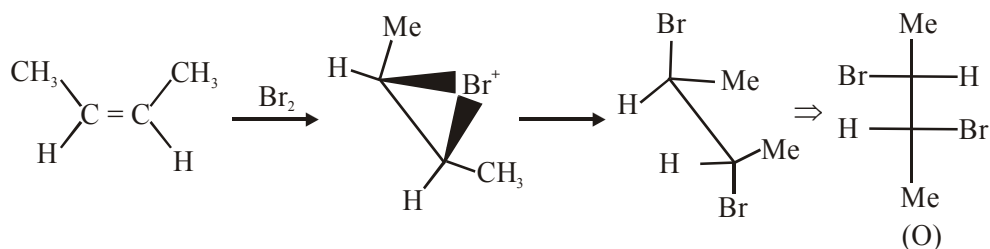
(C) O and P are identical molecules

(D) (M and O) and (N and P) are two pairs of enantiomers

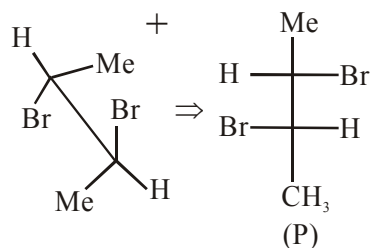
20. Ans.(A,B)



(M) and (N) are identical meso compounds



(ii)



(O) and (P) are enantiomers

Explanation of 4 options :

(A) (M) and (O) are distereomers of each other.

(N) and (P) are distereomers of each other.

(B) Addition of Br_2 on alkene follows non-classical carbocation mechanism. It is anti or trans addition.

(C) (O) and (P) are enantiomers

(D) (M) and (N) are identical and (O) and (P) are enantiomers.

(M and O) are distereomers and (N and P) are distereomers.

- 21.** Addition of excess aqueous ammonia to a pink coloured aqueous solution of $\text{MCl}_2 \cdot 6\text{H}_2\text{O}$ (X) and NH_4Cl gives an octahedral complex Y in the presence of air. In aqueous solution, complex Y behaves as 1 : 3 electrolyte. The reaction of X with excess HCl at room temperature results in the formation of a blue coloured complex Z. The calculated spin only magnetic moment of X and Z is 3.87 B.M., whereas it is zero for complex Y.

Among the following options, which statements is(are) correct ?

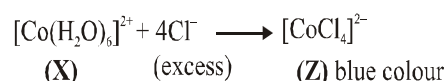
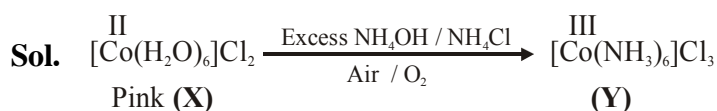
(A) The hybridization of the central metal ion in Y is d^2sp^3

(B) Z is tetrahedral complex

(C) Addition of silver nitrate to Y gives only two equivalents of silver chloride

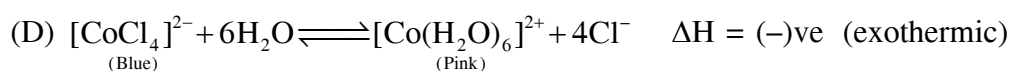
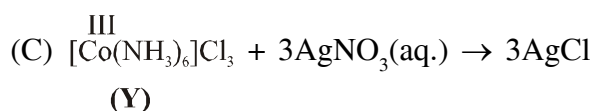
(D) When X and Z are in equilibrium at 0°C , the colour of the solution is pink

21. Ans. (A,B,D)



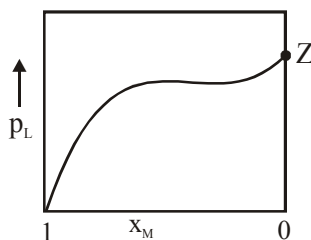
(A) Hybridisation of (Y) is d^2sp^3 as NH_3 is strong field ligand

(B) $[\text{CoCl}_4]^{2-}$ have sp^3 hybridisation as Cl^- is weak field ligand



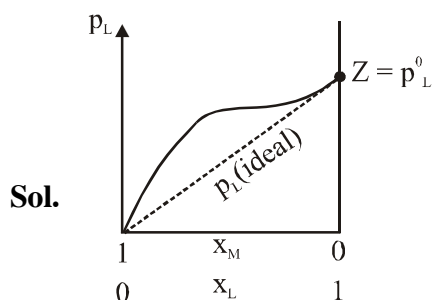
When ice is added to the solution the equilibrium shifts right hence pink colour will remain predominant
So, correct answer is (A,B& D)

22. For a solution formed by mixing liquids L and M, the vapour pressure of L plotted against the mole fraction of M in solution is shown in the following figure, Here x_L and x_M represent mole fractions of L and M, respectively, in the solution. the correct statement(s) applicable to this system is(are) -



- (A) Attractive intramolecular interactions between L–L in pure liquid L and M–M in pure liquid M are stronger than those between L–M when mixed in solution
- (B) The point Z represents vapour pressure of pure liquid M and Raoult's law is obeyed when $x_L \rightarrow 0$
- (C) The point Z represents vapour pressure of pure liquid L and Raoult's law is obeyed when $x_L \rightarrow 1$
- (D) The point Z represents vapour pressure of pure liquid M and Raoult's law is obeyed from $x_L = 0$ to $x_L = 1$

22. Ans.(A,C)



- (A) This is case of positive deviation hence

$$F_{L-L}, F_{M-M} > F_{L-M}$$

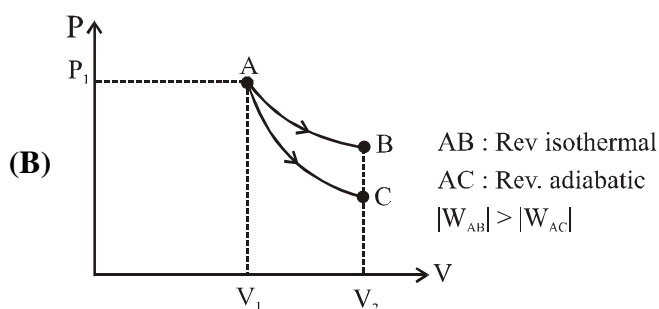
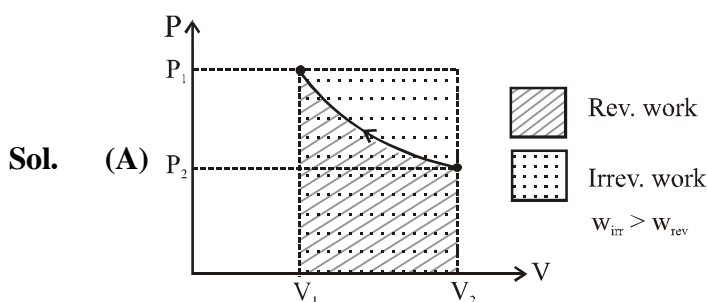
- (C) $P_L \geq P_L^0 X_L$

but when $x_L \rightarrow 1$, mixture has almost pure liquid L so, $P_L \rightarrow P_L^0$

23. An ideal gas is expanded from (p_1, V_1, T_1) to (p_2, V_2, T_2) under different conditions. The correct statement(s) among the following is(are)

- (A) The work done on the gas is maximum when it is compressed irreversibly from (p_2, V_2) to (p_1, V_1) against constant pressure p_1
- (B) The work done on the gas is less when it is expanded reversibly from V_1 to V_2 under adiabatic conditions as compared to that when expanded reversibly from V_1 to V_2 under isothermal conditions.
- (C) The change in internal energy of the gas (i) zero, if it is expanded reversibly with $T_1 = T_2$, and (ii) positive, if it is expanded reversibly under adiabatic conditions with $T_1 \neq T_2$
- (D) If the expansion is carried out freely, it is simultaneously both isothermal as well as adiabatic

23. Ans. (A,B,D)



(C) (i) $\Delta U = nC_v \Delta T = 0$ (isothermal hence $\Delta T = 0$)

(ii) $\Delta U = q + w = -ve$ ($q = 0$, $w < 0$)

$$\Delta U = nC_v \Delta T \Rightarrow \Delta T < 0$$

(D) $q = 0$ (adiabatic), $w = 0$ (free expansion)

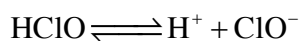
$$\Delta U = 0 \Rightarrow \Delta T = 0 \text{ (isothermal)}$$

24. The correct statement(s) about the oxoacids, HClO_4 and HClO , is (are) -

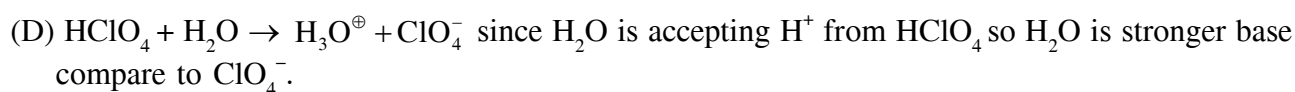
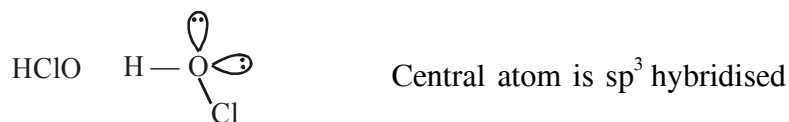
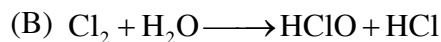
- (A) HClO_4 is more acidic than HClO because of the resonance stabilization of its anion
- (B) HClO_4 is formed in the reaction between Cl_2 and H_2O
- (C) The central atom in Both HClO_4 and HClO is sp^3 hybridized
- (D) The conjugate base of HClO_4 is weaker base than H_2O

24. Ans.(A,C,D)

Sol. Hint :



$\therefore \text{HClO}_4$ is more acidic than HClO .



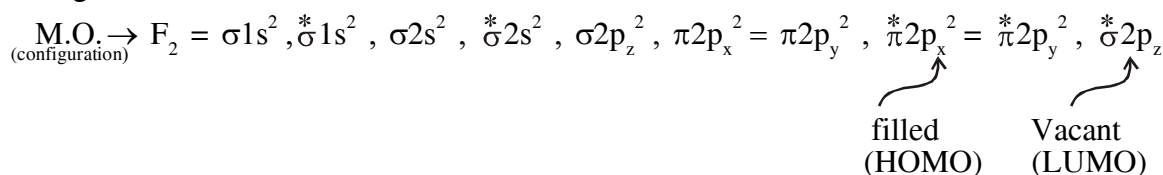
25. The colour of the X_2 molecules of group 17 elements changes gradually from yellow to violet down the group. This is due to -

- (A) the physical state of X_2 at room temperature changes from gas to solid down the group
- (B) decrease in HOMO-LUMO gap down the group
- (C) decrease in $\pi^*-\sigma^*$ down the group
- (D) decrease in ionization energy down the group

25. Ans.(B & C)

Sol.

Halogens are coloured due to HOMO-LUMO transition of electrons.



On moving down the group HOMO-LUMO energy gap decreases so transition of electrons become easier $\pi^* 2p$ to $\sigma^* 2p$ therefore colour intensify.

SECTION-2 : (Maximum Marks : 15)

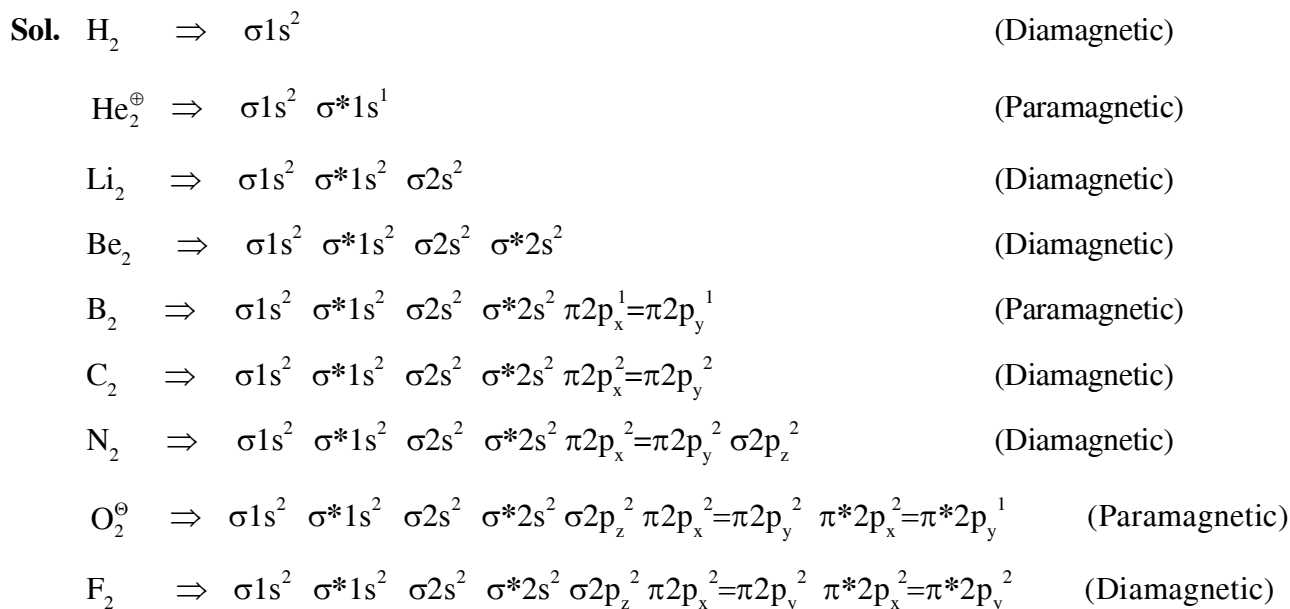
- This section contains **FIVE** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +3 If only the bubble corresponding to the correct answer is darkened.

Zero Marks : 0 In all other cases.

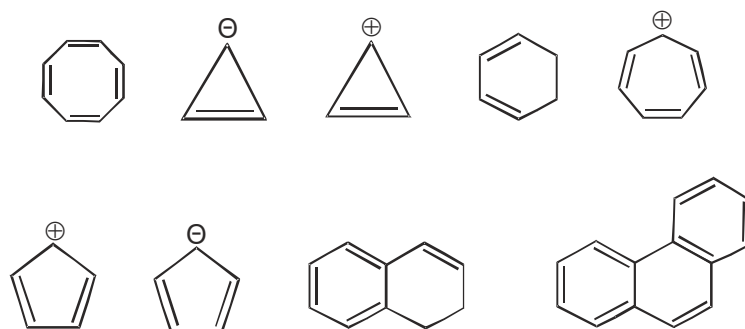
26. Among H_2 , He_2^+ , Li_2 , Be_2 , B_2 , C_2 , N_2 , O_2^- , and F_2 , the number of diamagnetic species is -
(Atomic number) : H = 1, He = 2, Li = 3, Be = 4, B = 5, C = 6, N = 7, O = 8, f = 9)

26. Ans.(5 or 6)



If existence of Be_2 is considered in atomic form or very weak bonded higher energetic species having zero bond order then it is diamagnetic, then answer will be 6. But if existence of molecular form of Be_2 is not considered then magnetic property can't be predicted then answer will be 5.

27. Among the following, the number of aromatic compound (s) is-



27. Ans.(5)

Sol.



Cyclooctatetraene ; **non aromatic**

Due to nonplanarity of ring the π -electrons are not delocalised.



Cyclopropenyl anion ; **Anti aromatic**

4π -electrons delocalised.



Cyclopropenyl cation ; **Aromatic**

2π -electrons delocalised.



Cyclohexadiene : **Non-aromatic**



Tropylium ion : **Aromatic**

6π -electrons delocalised.

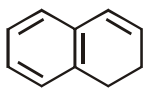


Cyclopentadienyl cation ; **Anti-aromatic**

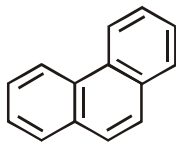
4π -electrons delocalised.



Cyclopentadienyl anion ; **Aromatic**
6 π -electrons delocalised.



aromatic



aromatic
14 πe^- s
(delocalised)

28. The conductance of a 0.0015 M aqueous solution of a weak monobasic acid was determined by using a conductivity cell consisting of platinized Pt electrodes. The distance between the electrodes is 120 cm with an area of cross section of 1 cm². The conductance of this solution was found to be 5×10^{-7} S. The pH of the solution is 4. The value of limiting molar conductivity (Λ_m^0) of this weak monobasic acid in aqueous solution is $Z \times 10^2$ S cm⁻¹ mol⁻¹. The value of Z is.

28. **Ans.(6)**

Sol. For weak acid $[H^+] = c\alpha = c \frac{\Lambda_m^c}{\Lambda_m^\infty} = c \times \frac{\kappa \times \frac{1000}{c}}{\Lambda_m^\infty} = \frac{\kappa \times 1000}{\Lambda_m^\infty} = \frac{G \times \left(\frac{l}{a}\right) \times 1000}{\Lambda_m^\infty}$

$$10^{-4} = \frac{5 \times 10^{-7} \times \left(\frac{120}{1}\right) \times 1000}{Z \times 10^2} \Rightarrow Z = 6$$

29. The sum of the number of lone pairs of electrons on each central atom in the following species is.
[TeBr₆]²⁻, [BrF₂]⁺, SNF₃ and [XeF₃]⁻

[Atomic number : N = 7, F = 9, S = 16, Br = 35, Te = 52, Xe = 54]

29. **Ans.(6)**

Sol.

	Number of σ -bonds formed by central atom	Number of lone pairs on central atom
(i) In [TeBr ₆] ²⁻	6	1
(ii) In [BrF ₂] ⁺	2	2
(iii) In SNF ₃	4	0
(iv) In [XeF ₃] ⁻	3	3

$$\Rightarrow \text{Total number of lone pairs of electrons} = 1 + 2 + 0 + 3 = 6$$

30. A crystalline solid of a pure substance has a face-centred cubic structure with a cell edge of 400 pm. If the density of the substance in the crystal is 8 g cm^{-3} , then the number of atoms present in 256g of the crystal is $N \times 10^{24}$. The value of N is

30. **Ans.(2)**

Sol.

$$\text{Formula of density} = \frac{Z \times M}{N_A \times a^3}$$

For FCC unit cell $Z = 4$

Edge length $a = 4 \times 10^{-8} \text{ cm}$

$$M = \frac{d \times N_A \times a^3}{Z} = \frac{8 \times 6 \times 10^{23} \times 64 \times 10^{-24}}{4} \text{ gm/mol}$$

$$\text{No. of atoms} = \frac{\text{wt(gm)}}{\text{molar mass}} \times N_A = \frac{256 \times 10 \times 6 \times 10^{23}}{8 \times 6 \times 16} = 2 \times 10^{24} \text{ (Value of } N = 2)$$

SECTION-3 : (Maximum Marks : 18)

- This section contains **SIX** questions of matching type.
- This section contains **TWO** tables (each having 3 columns and 4 rows)
- Based on each table, there are **THREE** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

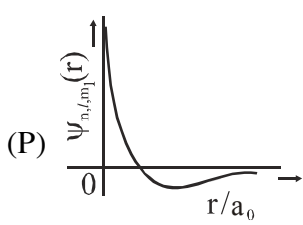
Full Marks : +3 If only the bubble corresponding to the correct option is darkened.

Zero Marks : 0 If none of the bubbles is darkened.

Negative Marks : -1 In all other cases

Answer Q.31, Q.32 and Q.33 by appropriately matching the information given in the three columns of the following table.

The wave function ψ_{n,l,m_l} is a mathematical function whose value depends upon spherical polar coordinates (r, θ , ϕ) of the electron and characterized by the quantum numbers n, l and m_l . Here r is distance from nucleus, θ is colatitude and ϕ is azimuth. In the mathematical functions given in the Table, Z is atomic number a_0 is Bohr radius.

Column-1	Column-2	Column-3
(I) 1s orbital	(i) $\psi_{n,l,m_l} \propto \left(\frac{Z}{a_0}\right)^{\frac{3}{2}} e^{-\left(\frac{Zr}{a_0}\right)}$	(P) 
(II) 2s orbital	(ii) One radial node	(Q) Probability density at nucleus $\propto \frac{1}{a_0^3}$
(III) 2p _z orbital	(iii) $\psi_{n,l,m_l} \propto \left(\frac{Z}{a_0}\right)^{\frac{5}{2}} re^{-\left(\frac{Zr}{2a_0}\right)} \cos \theta$	(R) Probability density is maximum at nucleus
(IV) 3d _{z²} orbital	(iv) xy - plane is a nodal plane	(S) Energy needed to excite electron from n = 2 state to n = 4 state is $\frac{27}{32}$ times the energy needed to excite electron from n = 2 state to n = 6 state

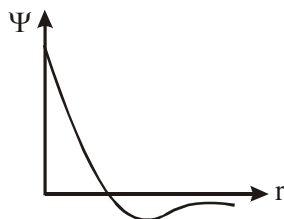
31. For the given orbital in column 1, the only **CORRECT** combination for any hydrogen - like species is :

- (A) (IV) (iv) (R) (B) (II) (ii) (P) (C) (III) (iii) (P) (D) (I) (ii) (S)

31. **Ans.(B)**

Sol. (A) (IV) (iv) (R) $\Rightarrow$ incorrect, because, d_{z^2} has no nodal plane.

(B) (II) (ii) (P) $\Rightarrow$ correct, because 2s orbital has 1 radial node.



(C) (III) (iii) (P) $\Rightarrow$ incorrect, because probability density for 2p at nucleus is zero.

(D) (I) (ii) (S) $\Rightarrow$ incorrect, because 1s orbital has no radial node.

32. For He^+ ion, the only **INCORRECT** combination is

- (A) (II) (ii) (Q) (B) (I) (i) (S) (C) (I) (i) (R) (D) (I) (iii) (R)

32. **Ans. (D)**

Sol. The option (D) is incorrect because in the wave function of 1s orbital, no angular function should be present.

33. For hydrogen atom, the only **CORRECT** combination is

- (A) (I) (iv) (R) (B) (I) (i) (P) (C) (II) (i) (Q) (D) (I) (i) (S)

33. **Ans. (D)**

Sol. We have to select only correct combination hence, the option (D) is correct.

$$\text{For 1s orbital : } \Psi_{n,l,m} \propto \left(\frac{Z}{a_0}\right)^{3/2} e^{-\frac{Zr}{a_0}}$$

Energy needed to excite : from $n = 2$ to $n = 4$

$$\Delta E_{2-4} = 13.6 Z^2 \times \frac{3}{16} \text{ eV}$$

Energy needed to excite from : $n = 2$ to $n = 6$

$$\Delta E_{2-6} = 13.6 Z^2 \times \frac{8}{36}$$

$$\Delta E_{2-4} = \frac{27}{32} \Delta E_{2-6} \text{ (hence, true)}$$

Answer Q.34, Q.35 and Q.36 by appropriately matching the information given in the three columns of the following table.

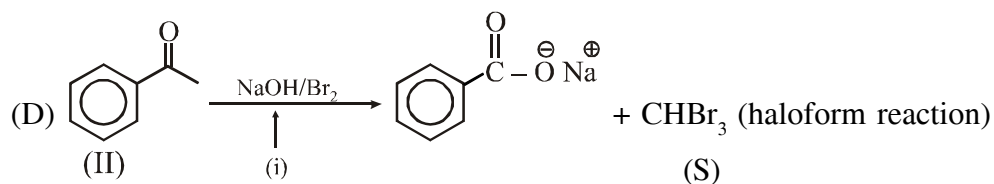
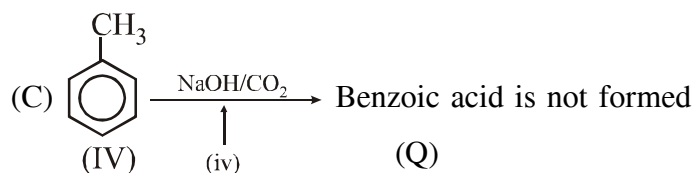
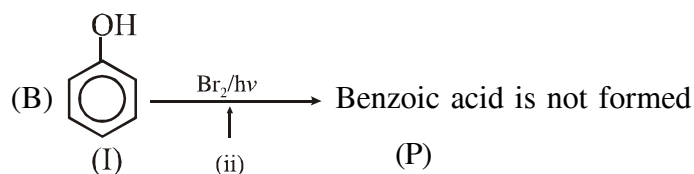
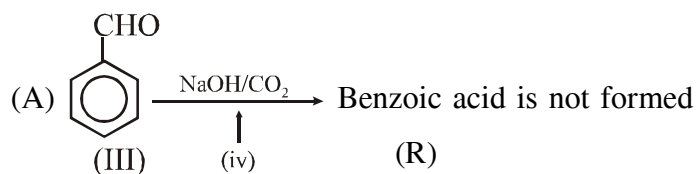
Columns 1, 2 and 3 contains starting materials, reaction conditions, , and type of reactions, respectively .		
Column 1	Column 2	Column 3
(I) Toluene	(i) NaOH/Br ₂	(P) Condensation
(II) Acetophenone	(ii) Br ₂ / hν	(Q) Carboxylation
(III) Benzaldehyde	(iii)(CH ₃ CO) ₂ O/CH ₃ COOK	(R) Substitution
(IV) Phenol	(iv) NaOH/CO ₂	(S) Haloform

34. For the synthesis of benzoic acid, the only CORRECT combination is

- (A) (III) (iv) (R) (B) (IV) (ii) (P) (C) (I) (iv) (Q) (D) (II) (i) (S)

34. Ans. (D)

Sol. (II)(i)(S)

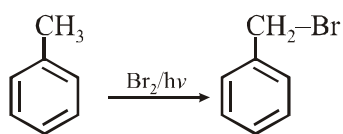


35. The only CORRECT combination in which the reaction proceeds through radical mechanism is

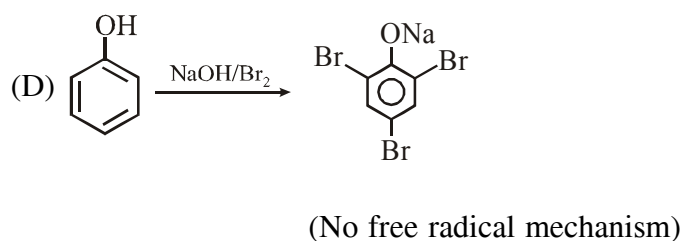
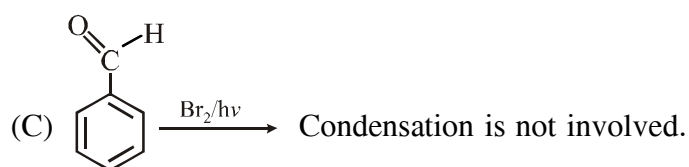
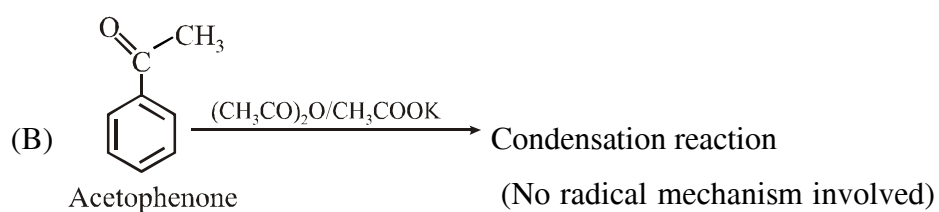
- (A) (I) (ii) (R) (B) (II) (iii) (R) (C) (III) (ii) (P) (D) (IV) (i) (Q)

35. Ans. [A](I)(ii)(R)

Sol.

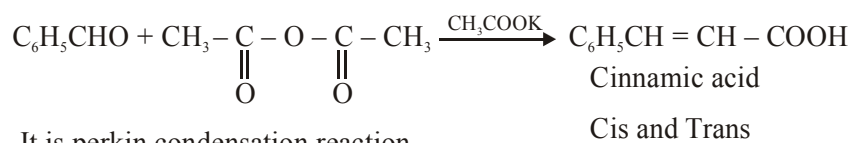


mechanism involved is free radical substitution



36. The only CORRECT combination that gives two different carboxylic acids is
 (A) (IV) (iii) (Q) (B) (III) (iii) (P) (C) (II) (iv) (R) (D) (I) (i) (S)

36. Ans.(B)



It is perkin condensation reaction

Mechanism

