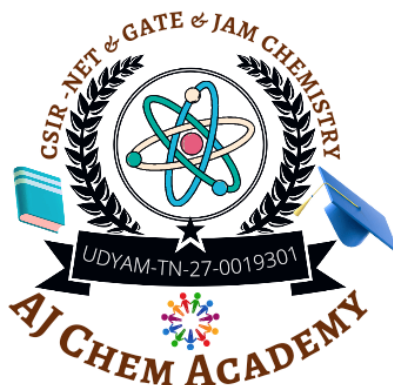


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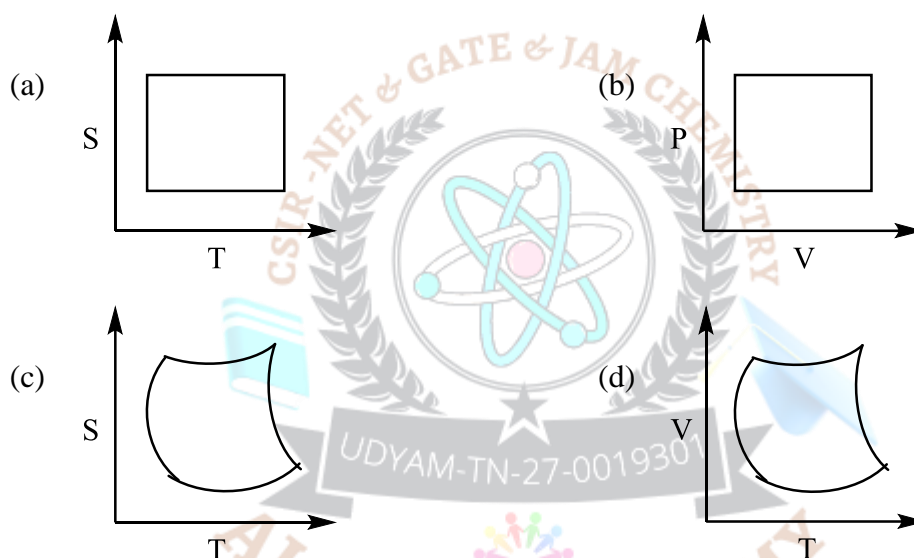
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Q.1 – Q.20 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

- A molecule has a 2-fold axis and a mirror plane perpendicular to that. The point group must have a
 (a) C_2 axis (b) Centre of inversion (c) σ_h plane (d) σ_v plane
- In the Huckel model for benzene, the π electronic transitions from the occupied to the unoccupied molecular orbitals do NOT occur at
 (a) 4β (b) 3β (c) 2β (d) 1β
- The plot that describes a Carnot cycle is:



- As the temperature tends to infinity, the partition function for a two-level system is
 (a) 0 (b) 1 (c) 2 (d) infinity
- As per the kinetic theory of ideal gases, which of the following statements is NOT correct?
 (a) gas particles have mass but no volume
 (b) particles are in a Brownian motion between collisions
 (c) during the collision, the system does not lose energy
 (d) particles exert same force per unit area on all sides of the container
- Which of the following statements is NOT correct regarding fugacity of a Van der Waals gas?
 (a) fugacity increases with increase in "b"
 (b) fugacity decreases with increase in "a"
 (c) fugacity is equal to zero if compressibility is zero

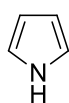


- (d) fugacity is equal to one if compressibility is one
7. The **homogeneous catalyst** that is used in the **hydroformylation** or **hydrocarbonylation** is based on
 (a) Co (b) Cr (c) Ti (d) V
8. The pair of ions that most commonly forms complexes with **coordination number 2** is
 (a) Cd(II) and Hg(II) (b) Cu(II) and Hg(I) (c) Cd(II) and Hg(I) (d) Cu(I) and Hg(II)
9. The **experimental magnetic moment** of $K_3[Fe(CN)_6]$ is **$2.3\mu_B$** and is attributable to the
 (a) spin-only value of a low-spin Fe (b) spin-only value of a high-spin Fe
 (c) low-spin Fe with orbital contribution (d) high-spin Fe with orbital contribution
10. **Iron-sulphur clusters** in biological systems are involved in
 (a) proton transfer (b) atom transfer (c) group transfer (d) electron transfer
11. **$Mg_6Si_4O_{10}(OH)_8$** is commercially known as
 (a) asbestos (b) water-glass (c) soda-glass (d) zeolite
12. The series with the correct order of **decreasing ionic size** is
 (a) $K^+ > Ca^{2+} > S^{2-} > Cl^-$ (b) $S^{2-} > Cl^- > K^+ > Ca^{2+}$
 (c) $K^+ > Cl^- > Ca^{2+} > S^{2-}$ (d) $Cl^- > K^+ > S^{2-} > Ca^{2+}$
13. The **most stable conformation** of the following compound is:

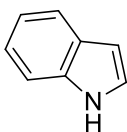


- (a)
- (b)
- (c)
- (d)

14. The **correct order of the basicity** of the following compound is



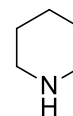
I



II



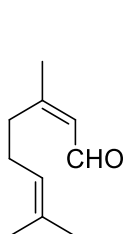
III



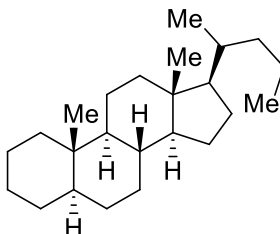
IV

- (a) IV > III > II > I (b) III > IV > I > II
 (c) IV > III > I > II (d) III > IV > II > I

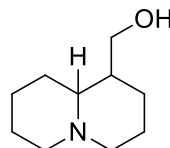
15. Match the following compounds with their respective classes,



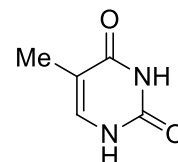
I



II



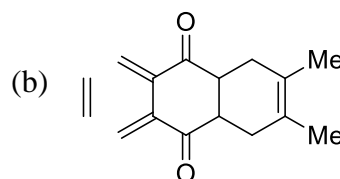
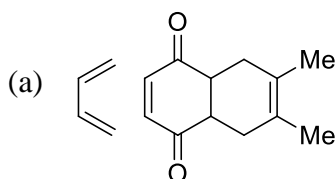
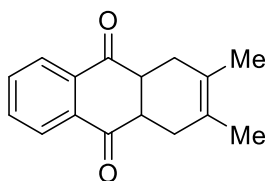
III

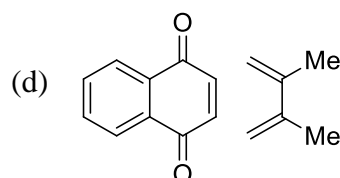
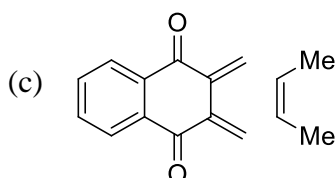


IV

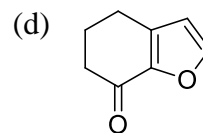
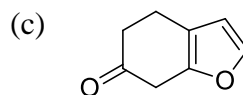
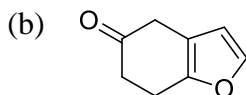
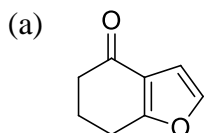
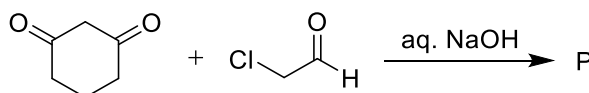
I	II	III	IV
(a) Steroid	; terpenoid	; alkaloid	; DNA base
(b) terpenoid	; Steroid	; alkaloid	; DNA base
(c) terpenoid	; Steroid	; DNA base	; alkaloid
(d) Steroid	; terpenoid	; DNA base	; alkaloid

16. Which of the following absorptions is shown by **1,3-butadiene** in its UV absorption spectrum recorded in **n-hexane** (ϵ_{\max} is the molar absorptivity)?
- (a) $\lambda_{\max} 217\text{nm} (\epsilon_{\max} = 21,000)$ (b) $\lambda_{\max} 214\text{nm} (\epsilon_{\max} = 210)$
 (c) $\lambda_{\max} 253\text{nm} (\epsilon_{\max} = 50,000)$ (d) $\lambda_{\max} 250\text{nm} (\epsilon_{\max} = 500)$
17. Which of the following compounds is expected to show a **sharp singlet** for one of its protons at $\delta \geq 8$ ppm in $^1\text{H-NMR}$ spectrum, given that this **signal remains unaffected on shaking the solution thoroughly with D_2O** ?
- (a) $\text{CH}_3\text{CO}_2\text{H}$ (b) $\text{CH}_3\text{CONHC}_6\text{H}_5$ (c) $\text{n-C}_6\text{H}_{13}\text{C}\equiv\text{CH}$ (d) $\text{n-C}_6\text{H}_{13}\text{CHO}$
18. The **most appropriate starting materials** for one step synthesis of the given compound are

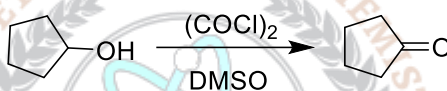




19. Identify the **major product-P** in the following reaction.



20. Which of the statement is **CORRECT** about the mechanism of the following reaction?



(a) DMSO reacts with alcohol initially to give , which reacts with (COCl)₂

(b) (COCl)₂ reacts with the alcohol initially to give , which reacts with DMSO

(c) DMSO reacts with (COCl)₂ initially to give , which reacts with the alcohol

(d) (COCl)₂ reacts with DMSO initially to give which reacts with the alcohol

Q.21 – Q.85 Multiple Choice Question (MCQ), carry TWO marks each (for each wrong answer: – 2/3).

21. To demonstrate the variational principle, a trial function $\varphi = C_1 \frac{\varphi_{2s} + \varphi_{3s}}{\sqrt{2}} + C_2 \frac{\varphi_{2s} - \varphi_{3s}}{\sqrt{2}}$ where C_1 and C_2 are the variational parameters and φ_{2s} and φ_{3s} are the 2s and 3s orbitals of the hydrogen atom, is constructed. The corresponding **secular determinant for the hydrogen atom** (in eV) is

(a)
$$\begin{vmatrix} 3.4(1 + 4/9)2 - E & 3.4(1 - 4/9)/2 \\ 3.4(1 - 4/9)/2 & 3.4(1 + 4/9)2 - E \end{vmatrix}$$

$$(b) \begin{vmatrix} 3.4(1 + 4/9)2 - E & 3.4(1 - 4/9)/2 \\ 3.4(1 - 4/9)/2 & 3.4(1 - 4/9)2 - E \end{vmatrix}$$

$$(c) \begin{vmatrix} 3.4(1 + 4/9)2 - E & 3.4(1 + 4/9)/2 \\ 3.4(1 - 4/9)/2 & 3.4(1 - 4/9)2 - E \end{vmatrix}$$

$$(d) \begin{vmatrix} 3.4(1 + 4/9)2 - E & 0 \\ 0 & 3.4(1 + 4/9)2 - E \end{vmatrix}$$

22. The $A_1 \rightarrow A_2$ transition for a molecule having C_{3v} symmetry is

- (a) due to dipole pointing in x direction (b) due to dipole pointing in y direction
(c) due to dipole pointing in z direction (d) not allowed

23. Which of the following pairs of operators commute?

- (a) x and $\frac{d}{dx}$ (b) $\frac{d}{dx}$ and $\frac{d^2}{dx^2} + 2\frac{d}{dx}$ (c) $x^2 \frac{d}{dx}$ and $\frac{d^2}{dx^2}$ (d) x^2 and $\frac{d}{dx}$

24. The zero-point energy of the vibration of $^{35}\text{Cl}_2$ mimicking a harmonic oscillator with a force constant $(k) = 2293.8 \text{ Nm}^{-1}$ is

- (a) $10.5 \times 10^{-21} \text{ J}$ (b) $14.8 \times 10^{-21} \text{ J}$ (c) $20 \times 10^{-21} \text{ J}$ (d) $29.6 \times 10^{-21} \text{ J}$

25. The molecule active in rotational microwave, infrared absorption as well as rotational Raman spectra is:

- (a) CO_2 (b) SF_6 (c) HCl (d) H_2

26. One mole each of H_2CO_3 , NaHCO_3 and Na_2CO_3 are added to water to prepare one litre solution. The pH of the solution is, ($\text{pK}_{a1} = 6.4$ and $\text{pK}_{a2} = 10.3$)

- (a) 6.37 (b) 8.31 (c) 10.25 (d) 7

27. Given the standard potential for the following half-cell reaction at 298 K



Calculate the $\Delta G^0 (\text{kJ})$ for the reaction, $2\text{Cu}^+_{(\text{aq})} \rightarrow \text{Cu}_{(\text{s})} + \text{Cu}^{2+}$

- (a) -34.740 (b) -65.720 (c) -69.480 (d) -131.440

28. One mole each of acetic acid and sodium acetate are dissolved in 1 kg of water. Boiling point of the resulting solution is

- (a) 100.51°C (b) 101.02°C (c) 101.53°C (d) 102.04°C

29. ΔS^0_{univ} for the following reaction, at 298 K is:



- (a) -197 JK^{-1} (b) 0 JK^{-1} (c) -308 JK^{-1} (d) 111 JK^{-1}

30. Consider an **exothermic reaction** $A \xrightleftharpoons[k_{-1}]{k_1} I$ **if the temperature increases**
- (a) K_1 , K_{-1} , and K_1/K_{-1} increases
 (b) K_1 increases, K_{-1} decreases, and K_1/K_{-1} increases.
 (c) K_1 , K_{-1} increases and K_1/K_{-1} decreases
 (d) K_1 and K_{-1} decrease, and K_1/K_{-1} increases.
31. A radical contains ^{14}N ($I = 1$) with **hyperfine constant 1.61 mT** and two equivalent protons ($I = \frac{1}{2}$) with **hyperfine constant 0.35 mT**. The **ESR spectrum will exhibit**,
- (a) 3 lines (b) 6 lines (c) 7 lines (d) 9 lines
32. The set of ions expected to show **Jahn-Teller distortion** in their complexes is
- (a) Ti(III), Cu(II), High-spin Fe(III) (b) Cu(I), Ni(II), High-spin Fe(III)
 (c) Cu(II), Low-spin Fe(III), Ti(III) (d) Low-spin Fe(III), Mn(II), Cu(I)
33. The series with correct order of **increasing Δ_o** in their complexes is:
- (a) $\text{I}^- < \text{PR}_3 < \text{CH}_3^- < \text{CO}$ (b) $\text{PR}_3 < \text{CH}_3^- < \text{I}^- < \text{CO}$
 (c) $\text{CH}_3^- < \text{PR}_3 < \text{I}^- < \text{CO}$ (d) $\text{I}^- < \text{CH}_3^- < \text{PR}_3 < \text{CO}$
34. **Coordinated water molecules of a Cd(II) complex** can be successively replaced by Br^- finally to result in $[\text{CdBr}_4]^{2-}$. In this process, the **fourth equilibrium constant is observed to be higher than the third one**, because
- (a) equilibrium constant for the last step is always the highest
 (b) three molecules of H_2O are released during the fourth step
 (c) the aquo-Cd(II) species is octahedral
 (d) an anion (Br^-) replaces a neutral (H_2O) molecule from the coordination sphere
35. The **CORRECT statement** regarding the **thermodynamic stability and kinetic reactivity** of metal ion complexes is that
- (a) more stable complexes are less reactive
 (b) there exists a dependence on the bulkiness of the ligand
 (c) there exists no direct relation between these two phenomenon
 (d) there exists a dependence on the size of the metal ion
36. The **CORRECT order** of the **rate of exchange of water molecules** between the coordination sphere and the bulk is:
- (a) $\text{Cr}^{3+} < \text{Al}^{3+} < \text{Cr}^{2+} < \text{Ni}^{2+}$
 (b) $\text{Cr}^{3+} < \text{Al}^{3+} < \text{Ni}^{2+} < \text{Cr}^{2+}$



- (c) $\text{Cr}^{3+} < \text{Ni}^{2+} < \text{Cr}^{2+} < \text{Al}^{3+}$
 (d) $\text{Cr}^{3+} < \text{Cr}^{2+} < \text{Al}^{3+} < \text{Ni}^{2+}$
37. The amino acid side chain high affinity for Ca^{2+} and Cu^{2+} in metallo-proteins is:
 (a) carboxylate in both the cases
 (b) imidazole in both the cases
 (c) carboxylate for Ca^{2+} and imidazole for Cu^{2+}
 (d) imidazole for Ca^{2+} and carboxylate for Cu^{2+}
38. The **CORRECT** order of the soft character (as per HSAB principle) of the central metal ion is
 (a) $[\text{CrO}_4]^{2-} < [\text{CrCl}_4]^- < [\text{Cr}(\text{bipy})_3] < [\text{Cr}(\text{CO})_5]^{2-}$
 (b) $[\text{CrCl}_4]^- < [\text{Cr}(\text{bipy})_3] < [\text{CrO}_4]^{2-} < [\text{Cr}(\text{CO})_5]^{2-}$
 (c) $[\text{CrO}_4]^{2-} < [\text{Cr}(\text{bipy})_3] < [\text{Cr}(\text{CO})_5]^{2-} < [\text{CrCl}_4]^-$
 (d) $[\text{CrCl}_4]^- < [\text{CrO}_4]^{2-} < [\text{Cr}(\text{CO})_5]^{2-} < [\text{Cr}(\text{bipy})_3]$
39. The crystal structure of Pb_3O_4 contains
 (a) octahedral and tetrahedral units (b) only octahedral units
 (c) octahedral and pyramidal units (d) octahedral and square-planar units
40. The symmetry elements that are present in BF_3 are
 (a) $\text{C}_3, \sigma_v, \sigma_h, 3\text{C}_2$ (b) $\text{C}_3, 3\text{C}_2, \text{S}_2, \sigma_v$ (c) $\text{C}_3, 3\text{C}_2, \sigma_h, \text{S}_2$ (d) $\text{C}_3, \sigma_h, \sigma_v, i$
41. $[\text{Co}(\text{CO})_4]$ is isolobal with
 (a) CH_4 (b) CH_3 (c) CH_2 (d) CH
42. The **CORRECT** order of the CO stretching vibrational frequency is
 (a) $[\text{Ti}(\text{CO})_6]^{2-} > [\text{V}(\text{CO})_6]^- > \text{CO} > [\text{Cr}(\text{CO})_6]$
 (b) $[\text{Cr}(\text{CO})_6] > \text{CO} > [\text{V}(\text{CO})_6]^- > [\text{Ti}(\text{CO})_6]^{2-}$
 (c) $\text{CO} > [\text{V}(\text{CO})_6]^- > [\text{Ti}(\text{CO})_6]^{2-} > [\text{Cr}(\text{CO})_6]$
 (d) $\text{CO} > [\text{Cr}(\text{CO})_6] > [\text{V}(\text{CO})_6]^- > [\text{Ti}(\text{CO})_6]^{2-}$
43. When a reduced cytochrome transfers an electron from its Fe(II) to the bound O_2 ,
 (a) The bond order of O_2 is reduced by one and ν_{O_2} decreases
 (b) A metal bound superoxide is formed and ν_{O_2} decreases
 (c) A metal bound superoxide is formed and ν_{O_2} increases
 (d) The bond order of O_2 is reduced by one and ν_{O_2} increases
44. The atomic radius (in cm) of an element with a body centered cubic unit cell of volume $75.8 \text{ cm}^3 \text{ mol}^{-1}$, molecular weight 137.3 and density 3.62 g cm^{-3} is

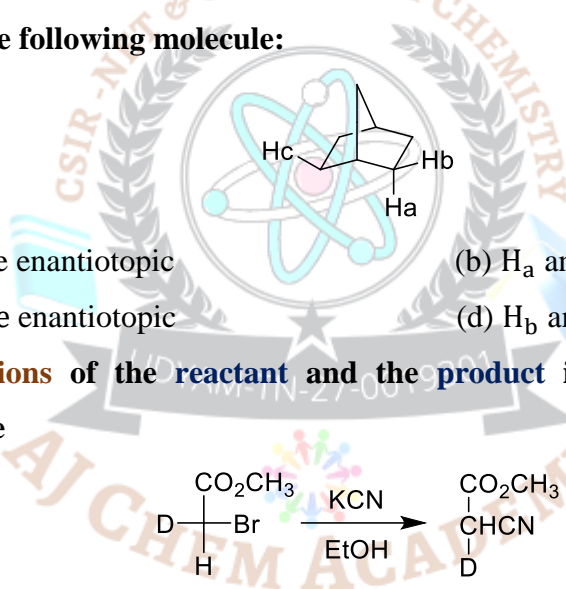


- (a) 1.5×10^{-8} (b) 1.6×10^{-8} (c) 2.0×10^{-8} (d) 2.2×10^{-8}
45. If the **dipole moment of HCl** is **1.08 D** and the **bond distance** is **1.27 Å**, then **partial charge on hydrogen and chlorine, respectively, are**
- (a) + 1.0 and –1.0 (b) + 0.85 and –0.85
(c) + 0.356 and –0.356 (d) +0.178 and –0.178
46. **One gram of ^{90}Sr gets converted to 0.953 g after 2 years. The half-life of ^{90}Sr and the amount of ^{90}Sr remaining after 5 years are**
- (a) 1.44 years and 0.916 g (b) 57.6 years and 0.75 g
(c) 28.8 years and 0.887 g (d) 100 years and 0.982 g
47. **The metal ion that is expected to shift the C_1 -methylene group in heptanol from 2 to 10 ppm in $^1\text{H-NMR}$ is**
- (a) Eu(III) (b) Tl(III) (c) Al(III) (d) Sc(III)
48. **When Al_4C_3 and Mg_2C_3 reacts with H_2O , then major products formed respectively, are**
- (a) ethyne and ethane (b) methane and propyne
(c) propane and propene (d) methane and propene
49. **The arrangement of sulphur in zinc blende and wurtzite structures, respectively, are**
- (a) hexagonal close packing and cubic close packing
(b) cubic close packing and hexagonal close packing
(c) simple cubic packing in both the structures
(d) hexagonal close packing in both the structures
50. **The reaction between Pr_6O_{11} and dilute HCl leads to the formation of**
- (a) a coloured solution (b) only a black precipitate PrO_2
(c) a black precipitate of PrO_2 and soluble PrCl_3 (d) only soluble PrCl_3
51. **$[\text{XeO}_6]^{4-}$ is octahedral whereas XeF_6 is a disordered one, because**
- (a) fluorine is more electronegative than oxygen
(b) Xe has a lone-pair in XeF_6
(c) XeF_6 is neutral whereas $[\text{XeO}_6]^{4-}$ is anionic
(d) Xe-F bond has more ionic character
52. **In biological systems, the metal ion involved in the dioxygen transport besides Fe is**
- (a) Co (b) Zn (c) Mg (d) Cu
53. **$[\text{Ru}(2,2' - \text{bipyridyl})_3]^{2+}$, when it absorbs at 452 nm, is a very good oxidizing as**

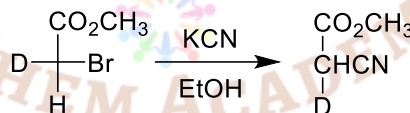


well as reducing agent due to the formation of

- (a) $[\text{Ru}^{\text{I}}(2, 2' - \text{bipyridyl})_3]^+$ (b) $[\text{Ru}^{\text{I}}(2, 2' - \text{bipyridyl})_2(2, 2' - \text{bipyridyl})]^{2+}$
 (c) $[\text{Ru}^{\text{III}}(2, 2' - \text{bipyridyl})_3]^{3+}$ (d) $[\text{Ru}^{\text{III}}(2, 2' - \text{bipyridyl})_2(2, 2' - \text{bipyridyl})]^{2+}$
54. In the proton decoupled ^{13}C and ^{31}P -NMR spectra of $(\text{CH}_3)_3\text{P}=\text{O}$, the number of lines observed, respectively, are
 (a) two and one (b) one and two (c) three and one (d) two and two
55. Among, RO^- , AsMe_3 , ROR' , CN^- , RCO_2^- , SCN^- , the set of ligands with good π -acceptor nature are
 (a) RO^- , RCO_2^- , SCN^- (b) RO^- , RCO_2^- , AsMe_3
 (c) AsMe_3 , CN^- , SCN^- (d) RO^- , ROR' , RCO_2^-
56. Identify the correct stereochemical relationship amongst the hydrogen atoms H_a , H_b and H_c in the following molecule:

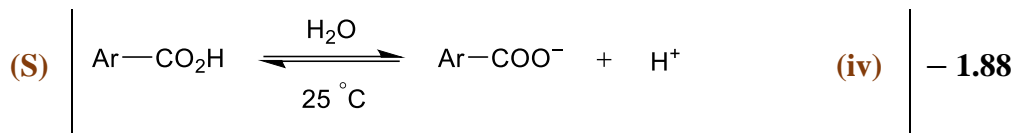


- (a) H_a and H_b are enantiotopic (b) H_a and H_b are diastereotopic
 (c) H_a and H_c are enantiotopic (d) H_b and H_c are diastereotopic.
57. The configurations of the reactant and the product in the following reaction, respectively, are



- (a) R, R (b) R, S (c) S, R (d) S, S
58. Match the reactions of some p -substituted benzene derivatives (P)–(S) given in List I with the Hammett's p -values (i) - (iv) in List II and identify the correct match.

	List – I	List – II
(P)	$\text{ArCH}_2\text{—Cl} \xrightarrow[70\text{ }^\circ\text{C}]{\text{aq. acetone}} \text{ArCH}_2\text{—OH} + \text{HCl} \quad (\text{i})$	+ 8.50
(Q)	$\text{ArCH}_2\text{—CO}_2\text{H} \xrightleftharpoons[25\text{ }^\circ\text{C}]{\text{H}_2\text{O}} \text{ArCH}_2\text{—COO}^- + \text{H}^+ \quad (\text{ii})$	+ 1
(R)	$\text{Ar—Cl} \xrightarrow[50\text{ }^\circ\text{C}]{\text{MeONa/MeOH}} \text{Ar—OMe} + \text{Cl}^- \quad (\text{iii})$	+ 0.49



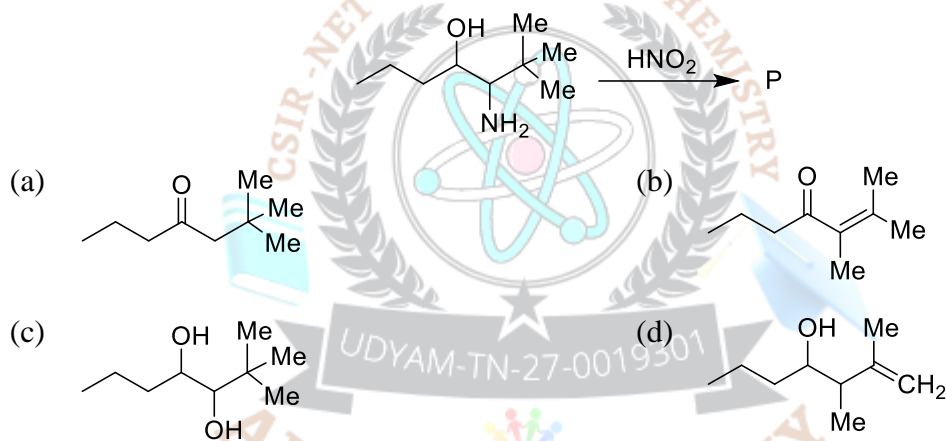
	P	Q	R	S
(a)	i ;	iv ;	iii ;	ii
(c)	i ;	ii ;	iv ;	iii

	P	Q	R	S
(b)	iv ;	i ;	ii ;	iii
(d)	iv ;	iii ;	i ;	ii

59. On heating with dilute sulfuric acid, naphthalene-1-sulfonic acid gives predominantly

- (a) naphthalene (b) naphthalene-2-sulfonic acid
(c) 1-naphthol (d) 2-naphthol

60. Predict the major product-P in the following reaction



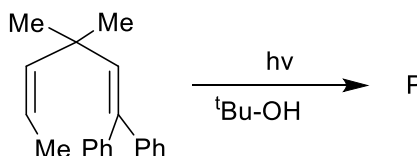
61. Select the correct classification in the following reaction from option I to IV gives below.

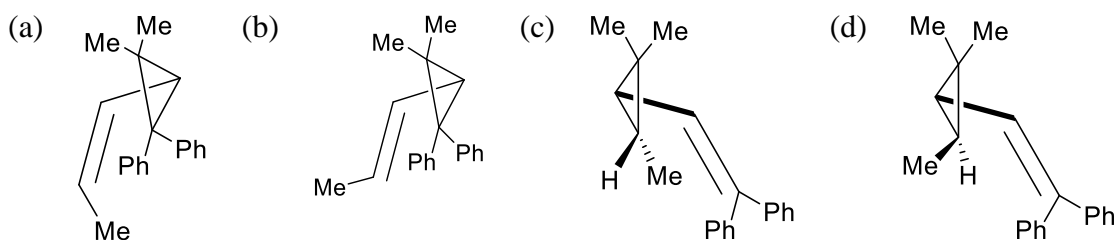


- (I) Conrotatory electrocyclic (II) Disrotatory electrocyclic
(III) Valence isomerization (IV) $[\pi^{4s} + \pi^{2a}]$ cycloaddition

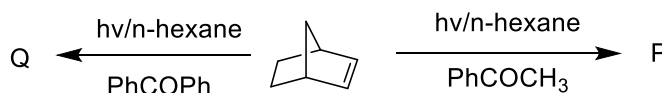
- (a) I and III (b) II and IV (c) II and III (d) I and IV

62. Identify the major product-P in the following reaction

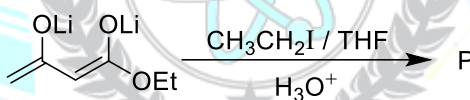




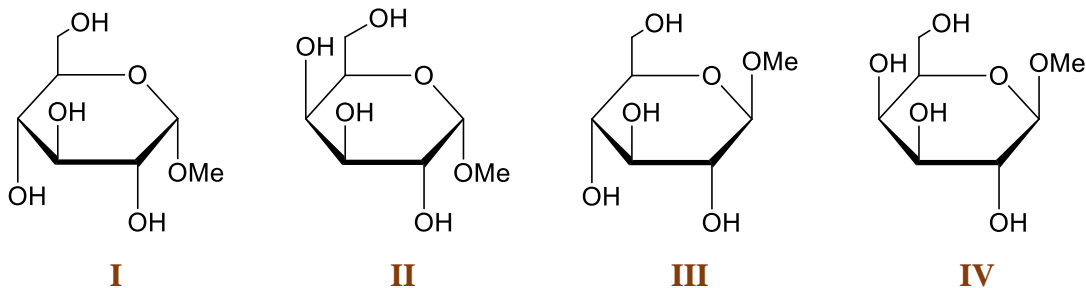
63. Identify the **major product 'P'** and **'Q'** in the following reactions from the list of **compounds I to IV**,



- (a) P:I and Q:II (b) P:II and Q:III (c) P:IV and Q:II (d) P:IV and Q: III
64. Identify the **major product-P** in the following reaction:



65. Identify the **Correct set of stereochemical relationships** amongst the following **monosaccharides I-IV**



- (a) I and II are anomers; III and IV are epimers
 (b) I and III are epimers; II and IV are anomers
 (c) I and II are epimers; III and IV are anomers

(d) I and III are anomers; I and II are epimers

66. Select the correct pair of statements:

- I.** Complementary strands run antiparallel in a double stranded DNA
- II.** The triplet codons, represented by the genetic code, are expressed by ribonucleic acids
- III.** t-RNA carries the genetic information to the site of DNA replication
- IV.** A nucleoside contains a ribose or deoxyribose and phosphate constituents only

(a) I and II (b) II and III (c) III and IV (d) I and IV

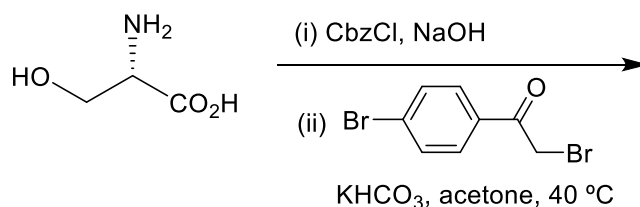
67. Match the compounds in **List - I** with the **stretching frequencies** (cm^{-1}) of the **principal functional groups** given in **List-II**.

List - I		List-II	
(P)		(i)	2240
(Q)		(ii)	1795
(R)		(iii)	1750
(S)		(iv)	1725
		(v)	1695

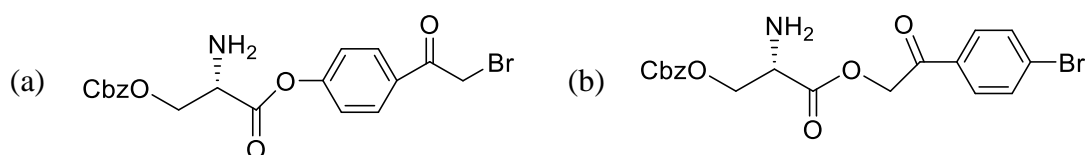
	P	Q	R	S
(a)	iii	iv	i	v
(c)	iv	v	ii	i

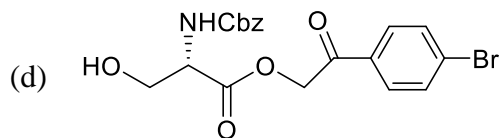
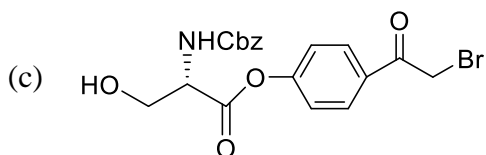
	P	Q	R	S
(b)	iii	iv	ii	v
(d)	iv	iii	v	i

68. Pick the **major product-P** in the following reaction

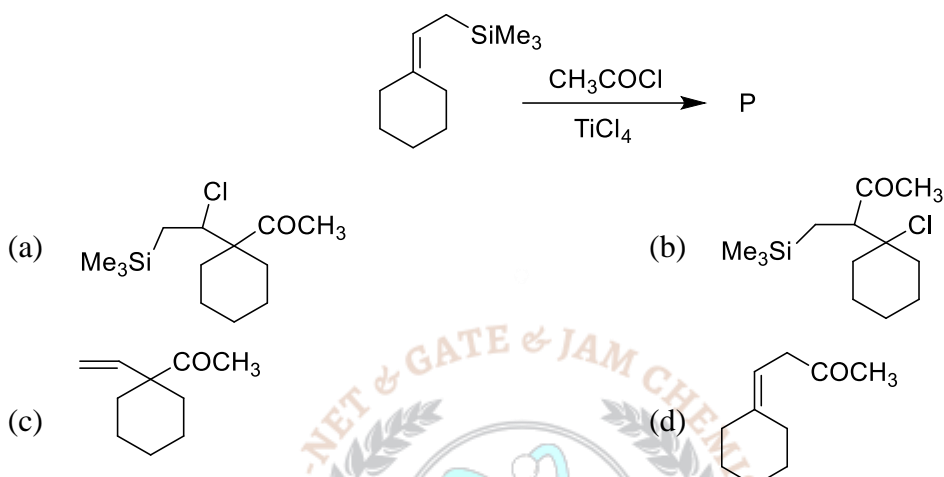


[CbzCl is $\text{PhCH}_2\text{OCOCl}$]

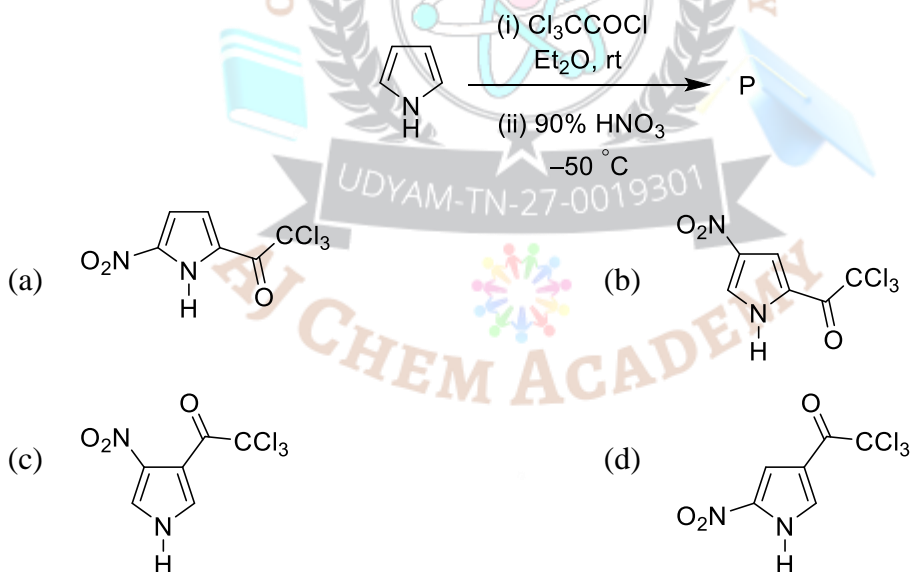




69. Identify the **major product-P** in the following reaction:



70. Identify the **major-P** in the following two-step reaction:



Common Data for Q.71, Q.72 and Q.73:

Methyl ethyl ether (A) and diborane (B) form a compound, which melts congruently at 133 K. The system exhibits two eutectics, one at 25 mole percent B and 123 K and a second at 90 mole percent B and 104 K. The melting points of pure A and B are 131 K and 110 K, respectively.

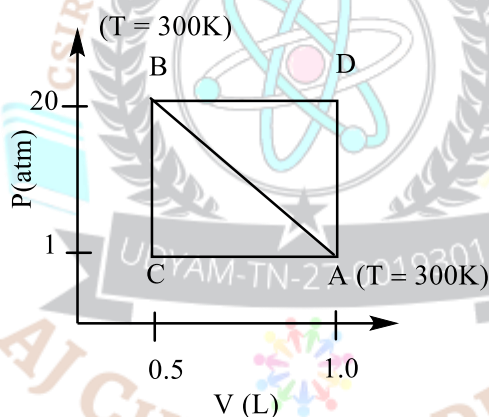
71. The **phases** at 55 mole percent 'B' and 108 K are,

- (a) solid AB and a solid B phase (b) solid AB and a liquid phase
(c) solid B and a liquid phase (d) solid A and a liquid phase

72. What happens if a **small amount of solid-B** is added to the above mixture while keeping the **temperature constant**?
- added B forms compound AB
 - added B precipitates out
 - overall liquid phase percentage increases with respect to the overall solid phase
 - complete solidification takes place
73. The mixture at **25 mole percent 'B'** and at **124 K** is cooled slowly to **114 K**. The **resulting phases** are
- solid AB and solid A
 - solid AB and liquid
 - solid AB and solid B
 - liquid and solid A

Common Data for Q. 74 and Q. 75.

Consider the following **P-V** diagram for an **ideal gas** that follows the **diagonal path** from A to B.



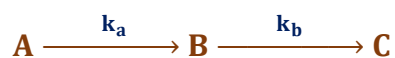
74. The **work done (in atm-L)** on the gas in the process is
- 9.5
 - 99.75
 - 190
 - $10 \ln (20)$
75. For the above process,
- $\Delta H = W$
 - $\Delta H = Q$
 - $\Delta H = \Delta G$
 - $\Delta H = \Delta E$

Linked Answer Q. 76 and Q.77.

76. The **first excited state** wavefunction for a **particle in a box** that spans from **$-a$ to $+a$** is
- $\sqrt{\frac{1}{a}} \cos \left(\frac{\pi x}{a} \right)$
 - $\sqrt{\frac{1}{a}} \sin \left(\frac{\pi x}{a} \right)$
 - $\sqrt{\frac{2}{a}} \cos \left(\frac{2\pi x}{a} \right)$
 - $\sqrt{\frac{2}{a}} \sin \left(\frac{2\pi x}{a} \right)$
77. A **perturbation $V = \delta(x - a/2)$** is introduced in the box. The **first order energy correction to the first excited state** is
- 0
 - $2/a$
 - $1/a$
 - $1/2a$

Linked Answer Q. 78 and Q.79.

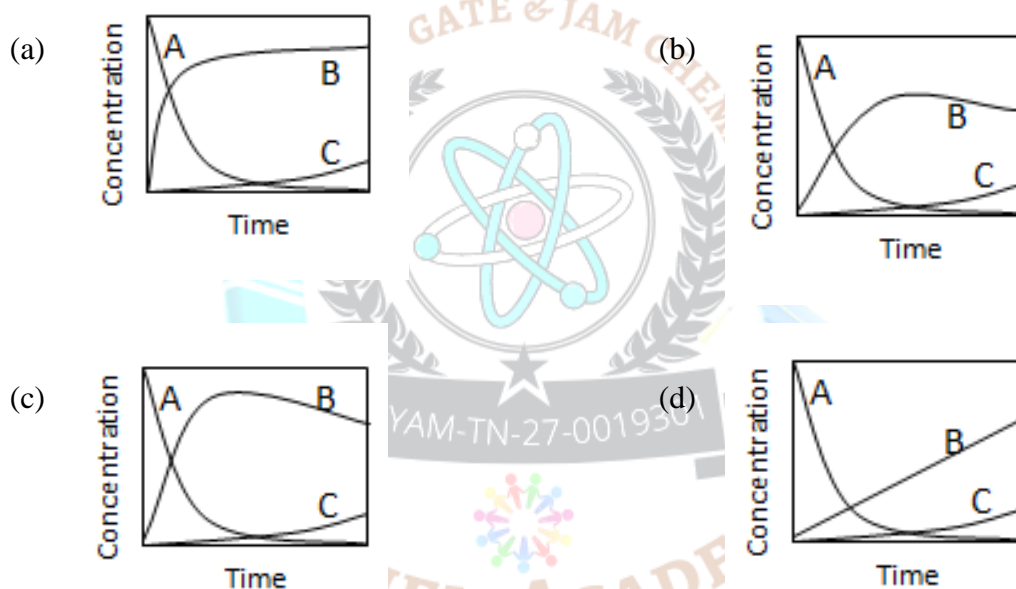
78. A reaction proceeds through the formation of an **intermediate-B** in an **unimolecular reaction**



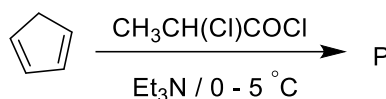
The **integrated rate law** for this reaction is

- (a) $[A] = [A]_0 e^{-k_a t}$ (b) $[A] = [A]_0 (e^{-k_a t} - e^{-k_b t})$
 (c) $[A] = \frac{[A]_0}{2} \left(1 + \frac{k_a e^{-k_b t} - k_b e^{-k_a t}}{k_a - k_b} \right)$ (d) $[A] = [A]_0 (1 + e^{-k_a t} - e^{-k_b t})$

79. If $k_a \gg k_b$, then **concentration vs. time plot** for the above reaction is:

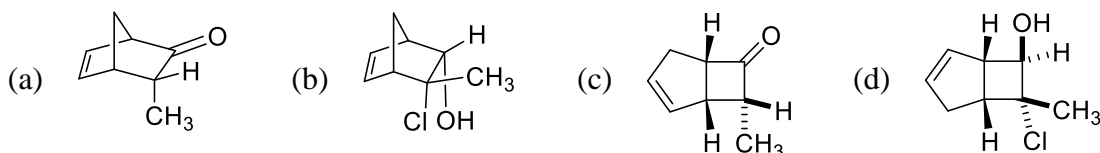
**Linked Answer Q.80 and Q.81:**

80. Identify the **major product-P** in the following reaction

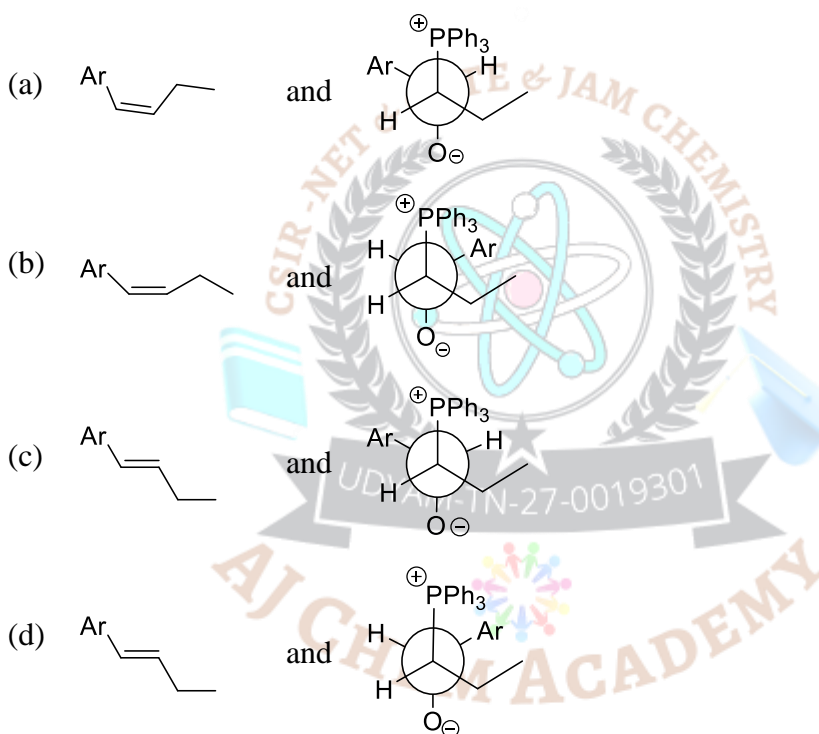
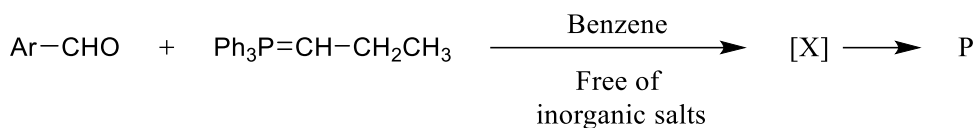


- (a) (b) (c) (d)

81. **Product-P** of the above reaction transforms to a **product-Q** on treatment with **n-Bu₃SnH** in the presence of **AIBN** in benzene solution. Identify **Q**,

**Linked Answer Q.82 and Q.83:**

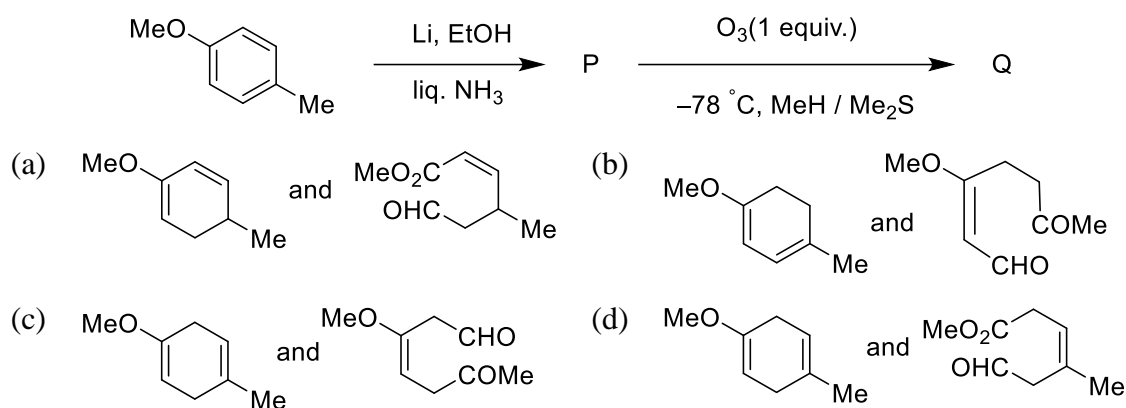
82. In the following **Wittig reaction**, the structure of the **major product-P** and the **intermediate [X]**, respectively, are



83. Which of the following sets of characteristic **NMR signals** will be compatible with the **structure of P** in the above reaction?
- (a) $\delta 7.18$ (d, $J = 6$ Hz, 2H), 7.01 (d, $J = 6$ Hz, 2H), 6.41 (d, $J = 18$ Hz, 1H)
- (b) $\delta 7.11$ (d, $J = 6$ Hz, 1H), 7.10 (s, 1H), 7.09 (t, $J = 5$ Hz, 1H), 6.94 (d, $J = 5$ Hz, 1H), 6.41 (d, $J = 17$ Hz, 1H)
- (c) $\delta 7.18$ (d, $J = 6$ Hz, 2H), 7.01 (d, $J = 6$ Hz, 2H), 6.35 (d, $J = 9$ Hz, 1H)
- (d) $\delta 7.11$ (d, $J = 6$ Hz, 1H), 7.10 (s, 1H), 7.09 (t, $J = 5$ Hz, 1H), 6.94 (d, $J = 5$ Hz, 1H), 6.35 (d, $J = 10$ Hz, 1H)

Linked Answer Type Q.84 and Q.85

84. The **products P and Q** in the following sequence of reactions, respectively, are



85. The reagent for **selective reduction of the aldehyde group** in Q obtained in the above reaction is

- (a) H_2 , $(\text{Ph}_3\text{P})_3\text{RhCl}$ (b) $((\text{H}_3\text{C})_2\text{CHCH}_2)_2\text{AlH}$ (c) $\text{Na}(\text{CH}_3\text{COO})_3\text{BH}$ (d) LiAlH_4

Answer Key

Q.No	Ans	Q.No	Ans	Q.No	Ans	Q.No	Ans
1.	b	26.	b	51.	b	76.	b
2.	d	27.	a	52.	d	77.	c
3.	a	28.	b	53.	d	78.	a
4.	c	29.	d	54.	a	79.	b
5.	a	30.	c	55.	c	80.	c
6.	c	31.	d	56.	b	81.	c
7.	a	32.	c	57.	d	82.	a
8.	d	33.	a	58.	d	83.	d
9.	c	34.	b	59.	a	84.	d
10.	d	35.	c	60.	a	85.	c
11.	a	36.	b	61.	c		
12.	b	37.	c	62.	a		
13.	c	38.	a	63.	b		
14.	a	39.	c	64.	a		
15.	b	40.	a	65.	d		
16.	a	41.	b	66.	a		
17.	d	42.	d	67.	c		
18.	d	43.	b	68.	d		
19.	a	44.	d	69.	c		
20.	c	45.	b	70.	b		
21.	a	46.	c	71.	b		
22.	d	47.	a	72.	b		
23.	b	48.	b	73.	a		
24.	b	49.	b	74.	c		
25.	c	50.	a	75.	d		

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