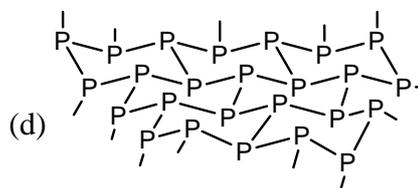
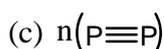
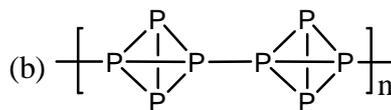
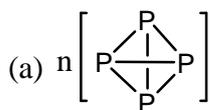


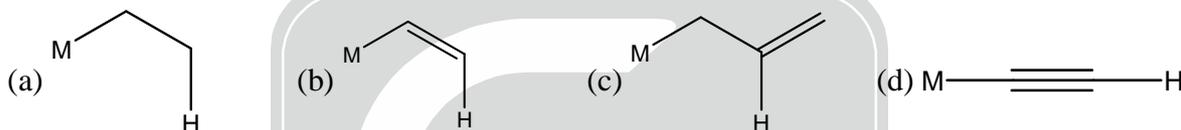
PAPER : CSIR-UGC-NET/JRF June 2015
CHEMICAL SCIENCES BOOKLET-[A]

Part-B

21. The biological functions of carbonic anhydrase and carboxypeptidase A, respectively, are
 (a) interconversion of CO_2 and carbonates, and hydrolysis of peptide bond
 (b) gene regulation and interconversion of CO_2 and carbonates
 (c) gene regulation and hydrolysis of peptide bond
 (d) interconversion of CO_2 and carbonates and gene regulation
22. The Fe–N_{porphyrin} bond distances in the deoxy and oxy-hemoglobin, respectively, are
 (a) ~ 2.1 and 2.0 \AA (b) ~ 2.0 and 2.0 \AA (c) ~ 2.2 and 2.3 \AA (d) ~ 2.3 and 2.5 \AA
23. The binding modes of NO in 18 electron compounds $[\text{Co}(\text{CO})_3(\text{NO})]$ and $[\text{Ni}(\eta^5\text{-Cp})(\text{NO})]$, respectively, are
 (a) linear and bent (b) bent and linear (c) linear and linear (d) bent and bent
24. The role of copper salt as co-catalyst in Wacker process is
 (a) oxidation of Pd(0) by Cu(II) (b) oxidation of Pd(0) by Cu(I)
 (c) oxidation of Pd(II) by Cu(I) (d) oxidation of Pd(II) by Cu(II)
25. For typical Fischer and Schrock carbenes, consider the following statements
 A. Oxidation state of metal is low in Fischer carbene and high in Schrock carbene
 B. Auxilliary ligands are π -acceptor in Fischer carbene and non- π -acceptor in Schrock carbene
 C. Substituents on carbene carbon are non- π -donor in Fischer carbene and π -donor in Schrock carbene
 D. Carbene carbon is electrophilic in Fischer carbene and nucleophilic in Schrock carbene
 The correct statements are
 (a) A, B and C (b) A, B and D (c) B, C and D (d) A, C and D
26. The species having the strongest gas phase proton affinity among the following,
 (a) N^{3-} (b) NF_3 (c) NH_3 (d) $\text{N}(\text{CH}_3)_3$
27. Consider the following statements regarding the diffusion current at dropping mercury electrode
 A. It does not depend on mercury flow rate
 B. It depends on drop time
 C. It depends on temperature
 Correct statement(s) is/are
 (a) A only (b) B only (c) A and B (d) B and C
28. Q value for the reaction $^{13}\text{N}(n, p)^{13}\text{C}$ is 3.236 MeV. The threshold energy (in MeV) for the reaction $^{13}\text{C}(p, n)^{13}\text{N}$ is
 (a) -3.236 (b) -3.485 (c) 3.485 (d) 3.845
29. The ^{119}Sn NMR chemical shift (approximately in ppm) corresponding to $(\eta^5\text{-Cp})_2\text{Sn}$ (relative to Me_4Sn) is
 (a) -4 (b) $+137$ (c) $+346$ (d) -2200
30. All forms of phosphorus upon melting, exist as



31. For the oxidation state(s) of sulphur atoms in S_2O , consider the following
 A. -2 and +4 B. 0 and +2 C. +4 and 0
 The correct answer(s) is/(are)
 (a) A and B (b) A and C (c) B and C (d) C only
32. The correct set of pseudohalide anions is
 (a) CN^- , ClO_4^- , BF_4^- , PF_6^- (b) N_3^- , NO_3^- , HSO_4^- , AsF_6^-
 (c) SCN^- , PO_4^{3-} , $H_2PO_4^-$, N_3^- (d) CN^- , N_3^- , SCN^- , NCN^{2-}
33. In transition metal phosphine ($M-PR_3$) complexes, the back-bonding involves donation of electrons from
 (a) $M(t_{2g}) \rightarrow PR_3(\sigma^*)$ (b) $M(t_{2g}) \rightarrow PR_3(\pi^*)$
 (c) $M(e_g) \rightarrow P(d)$ (d) $PR_3(\pi) \rightarrow M(t_{2g})$
34. The refluxing of $RhCl_3 \cdot 3H_2O$ with an excess of PPh_3 in ethanol gives a complex A. Complex A and the valence electron count on rhodium are, respectively,
 (a) $[RhCl(PPh_3)_3]$, 16 (b) $[RhCl(PPh_3)_5]$, 16 (c) $[RhCl(PPh_3)_3]$, 18 (d) $[RhCl(PPh_3)_5]$, 18
35. The β -hydrogen elimination will be facile in



36. The reaction $[Co(CN)_5 H_2O]^{2-} + X^- \rightarrow [Co(CN)_5 X]^{2-} + H_2O$ follows a/an
 (a) Interchange dissociative (I_d) mechanism (b) Dissociative (D) mechanism
 (c) Associative (A) mechanism (d) Interchange Associative (I_a) mechanism
37. Correct statement on the effect of addition of aq. HCl on the equilibrium is

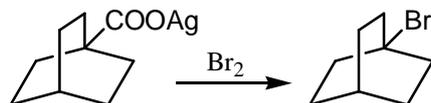


- (a) Equilibrium will shift towards right in case of both A and B
 (b) Equilibrium will shift towards left in case of both A and B
 (c) Equilibrium will shift towards right in A and left in case of B
 (d) Equilibrium will shift towards right in B and left in case of A.
38. The compound that exhibits sharp bands at 3300 and 2150 cm^{-1} in the IR spectrum is
 (a) 1-butyne (b) 2-butyne (c) butyronitrile (d) butylamine
39. The 1H NMR spectrum of a dilute solution of a mixture of acetone and dichloromethane in $CDCl_3$ exhibits two singlet of 1 : 1 intensity. Molar ratio of acetone to dichloromethane in the solution is
 (a) 3 : 1 (b) 1 : 3 (c) 1 : 1 (d) 1 : 2
40. Intense band generally observed for a carbonyl group in the IR spectrum is due to
 (a) The force constant of CO bond is large
 (b) The force constant of CO bond is small
 (c) There is no change in dipole moment for CO bond stretching
 (d) The dipole moment change due to CO bond stretching is large.

41. The compound that gives precipitate on warming with aqueous AgNO_3 is

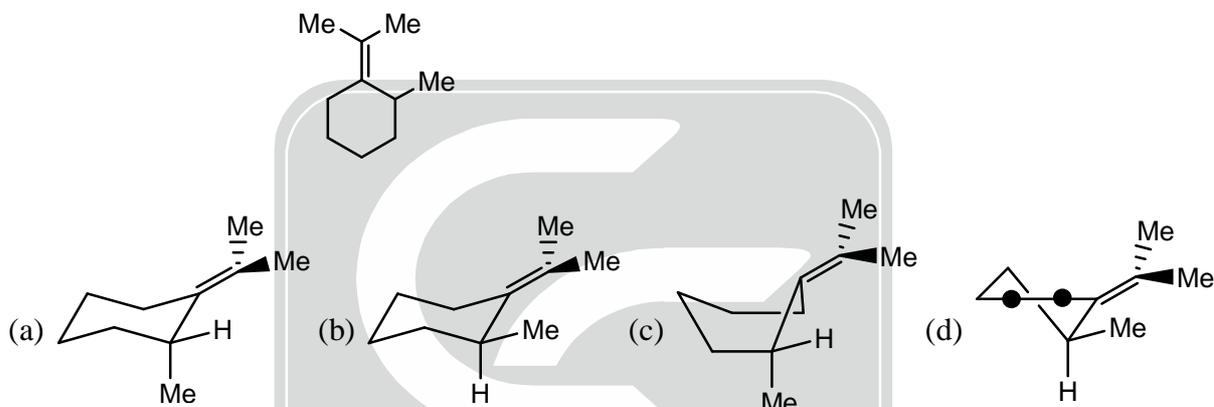


42. Following reaction goes through

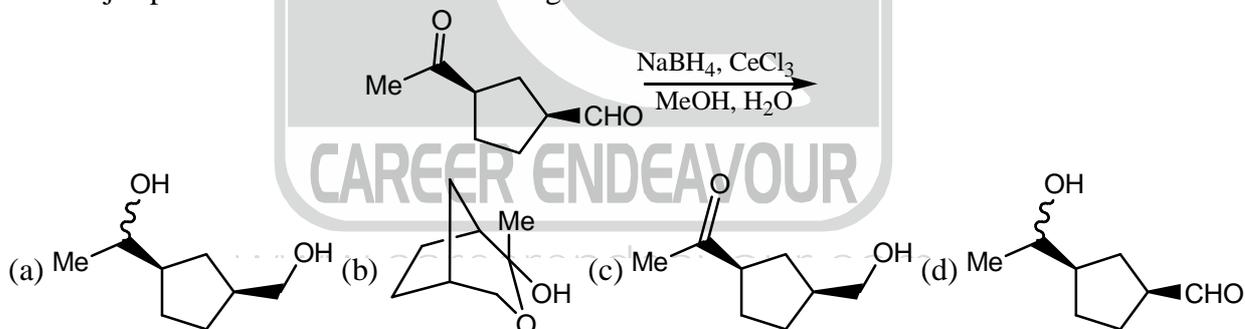


- (a) free radical intermediate (b) carbanion intermediate
(c) carbocation intermediate (d) carbene intermediate

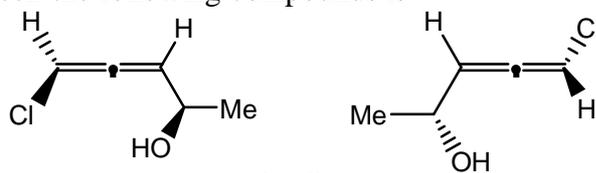
43. The most stable conformation for the following compound is



44. The major product formed in the following reaction is

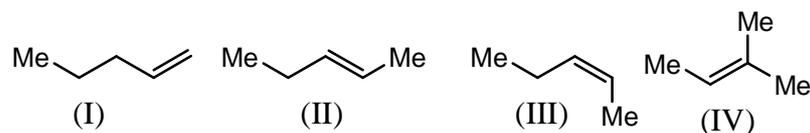


45. The correct relation between the following compounds is



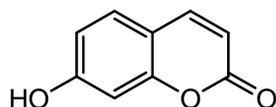
- (a) enantiomers (b) diastereomers
(c) homomers (identical) (d) constitutional isomers

46. The correct order of heat of hydrogenation for the following compounds is



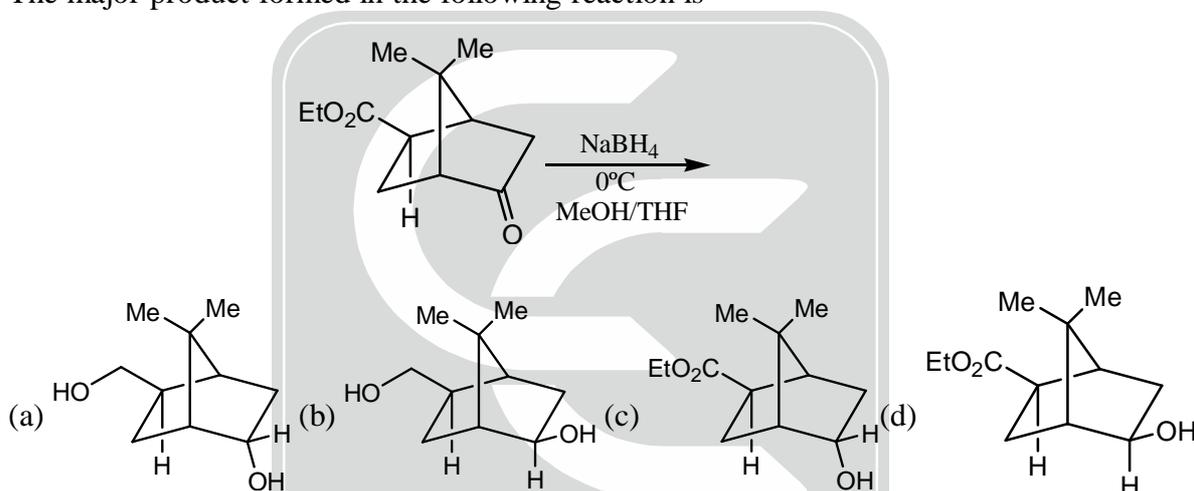
- (a) I > II > III > IV (b) I > III > II > IV (c) IV > I > III > II (d) IV > II > I > III

47. Among the following, the correct statement(s) about ribose is (are)
 (A) on reduction with NaBH_4 it gives optically inactive product.
 (B) on reaction with methanolic HCl it gives a furanoside
 (C) on reaction with $\text{Br}_2\text{-CaCO}_3\text{-water}$ it gives optically inactive product.
 (D) it gives positive Tollen's test
 (a) A, B and D (b) A, B and C (c) B and C (d) D only
48. Biogenetic precursors for the natural product umbelliferone among the following are

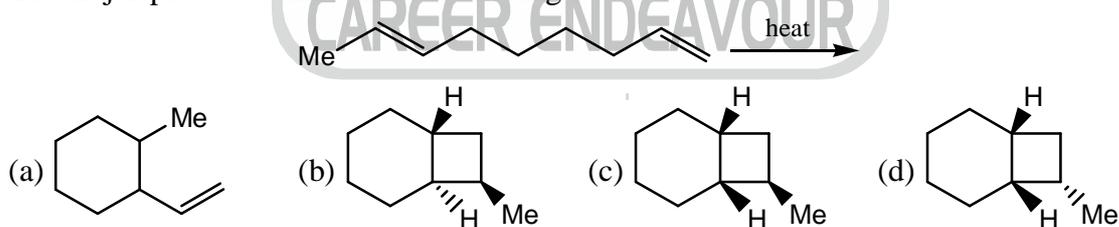


umbelliferone

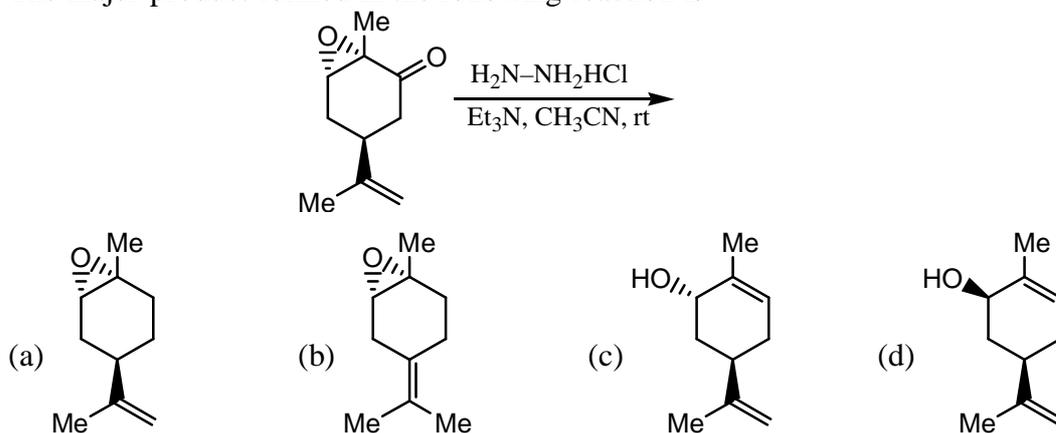
- (A) L-tryptophan (b) cinnamic acid (c) L-methionine (d) L-phenylalanine
49. Number of signals in the $^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of (R)-4-methylpentan-2-ol are
 (a) 3 (b) 4 (c) 5 (d) 6
50. The major product formed in the following reaction is



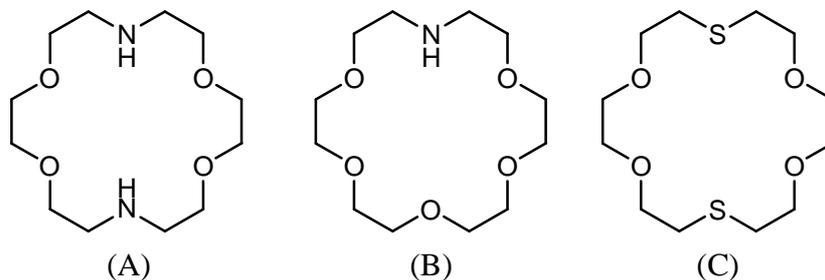
51. The major product formed in the following reaction is



52. The major product formed in the following reaction is

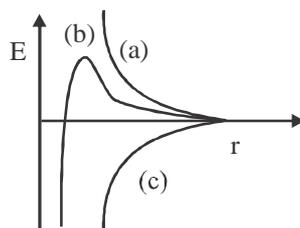


53. The magnitude of the stability constants for K^+ ion complexes of the following supra-molecular hosts follows the order,



- (a) $B > A > C$ (b) $C > A > B$ (c) $A > B > C$ (d) $C > B > A$
54. Antitubercular drug(s) among the following is (are)
 (A) Salbutamol (B) Ethambutanol (C) Isoniazid (D) Diazepam
 (a) A and B (b) B and C (c) C and D (d) D alone
55. A particle is in a one-dimensional box with a potential V_0 inside the box and infinite outside. An energy state corresponding to $n = 0$ (n : quantum number) is not allowed because
 (a) the total energy becomes zero
 (b) the average momentum becomes zero
 (c) the wave function becomes zero everywhere
 (d) the potential $V_0 \neq 0$
56. An eigenstate of energy satisfies $H\psi_n = E_n\psi_n$. In the presence of an extra constant potential V_0
 (a) both E_n and ψ_n will change (b) both E_n and average kinetic energy will change
 (c) only E_n will change, but not ψ_n (d) only ψ_n will change, but not E_n .
57. The intensity of a light beam decreases by 50% when it passes through a sample of 1.0 cm path length. The percentage of transmission of the light passing through the same sample, but of 3.0 cm path length, would be
 (a) 50.0 (b) 25.0 (c) 16.67 (d) 12.5
58. The electric-dipole allowed transition among the following is
 (a) $^3S \rightarrow ^3D$ (b) $^3S \rightarrow ^3P$ (c) $^1S \rightarrow ^1D$ (d) $^3S \rightarrow ^1F$
59. The product $C_2^x\sigma_{xy}$ (C_2^x is the two-fold rotation axis around the x -axis and σ_{xy} is the xy mirror plane) is
 (a) σ_{xz} (b) σ_{yz} (c) C_2^y (d) C_2^z
60. The simplest ground-state VB wave function of a diatomic molecule like HCl is written as $\psi = \psi_H(1s, 1)\psi_{Cl}(3p_z, 2) + B$, where B stands for
 (a) $\psi_H(3p_z, 2)\psi_{Cl}(1s, 1)$ (b) $\psi_H(1s, 2)\psi_{Cl}(3p_z, 1)$
 (c) $\psi_{Cl}(1s, 2)\psi_{Cl}(3p_z, 1)$ (d) $\psi_{Cl}(1s, 2)\psi_H(3p_z, 1)$
61. Heat capacity of a species is independent of temperature if it is
 (a) tetratomic (b) triatomic (c) diatomic (d) monatomic

62. In a chemical reaction : $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$, xenon gas is added at constant volume. The equilibrium
- (a) will shift towards the reactant
 (b) will shift towards the products
 (c) will not change the amount of reactant and products
 (d) will increase both reactant and products
63. The temperature-dependence of a reaction is given by $k = AT^2 \exp(-E_0 / RT)$
- The activation energy (E_a) of the reaction is given by
- (a) $E_0 + \frac{1}{2}RT$ (b) E_0 (c) $E_0 + 2RT$ (d) $2E_0 + RT$
64. For a reaction, $2A + B \rightarrow 3Z$, if the rate of consumption of A is $2 \times 10^{-4} \text{ mol dm}^{-3} \text{ s}^{-1}$ the rate of formation of Z (in $\text{mol dm}^{-3} \text{ s}^{-1}$) will be
- (a) 3×10^{-4} (b) 2×10^{-4} (c) $\frac{4}{3} \times 10^{-4}$ (d) 4×10^{-4}
65. Dominant contribution to the escaping tendency of a charged particle with uniform concentration in a phase, depends on
- (a) chemical potential of that phase (b) electric potential of the phase
 (c) thermal energy of that phase (d) gravitational potential of that phase
66. The intrinsic viscosity depends on the molar mass as $[\eta] = KM^a$
- The empirical constants K and a are dependent on
- (a) solvent only (b) polymer only
 (c) polymer solvent pair (d) polymer-polymer interaction
67. The correct ΔG for the cell reaction involving steps
- $$\text{Zn}(\text{s}) \rightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{e}^-$$
- $$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$$
- is
- (a) $\Delta G^0 - RT \ln \frac{a_{\text{Zn}^{2+}}}{a_{\text{Cu}^{2+}}}$ (b) $\Delta G^0 + RT \ln \frac{a_{\text{Zn}^{2+}}}{a_{\text{Cu}(\text{s})}}$ (c) $\Delta G^0 - RT \ln \frac{a_{\text{Zn}(\text{s})}}{a_{\text{Cu}^{2+}}}$ (d) $\Delta G^0 + RT \ln \frac{a_{\text{Zn}^{2+}}}{a_{\text{Cu}^{2+}}}$
68. The lowest energy-state of an atom with electronic configuration $ns^1 np^1$ has the term symbol
- (a) 3P_1 (b) 1P_1 (c) 3P_2 (d) 3P_0
69. Energy of interaction of colloidal particles as a function of distance of separation can be identified as (1) vander Waals, (2) double layer, (3) vander Waals and double layer. The correct order of interactions in the figure corresponding to curves (a), (b) and (c), respectively, is



- (a) 1, 2, 3 (b) 2, 3, 1 (c) 3, 1, 2 (d) 1, 3, 2

70. The packing factor (PF) and number of atomic sites per unit cell (N) of an FCC crystal system are
 (a) PF = 0.52 and N = 3 (b) PF = 0.74 and N = 3
 (c) PF = 0.52 and N = 4 (d) PF = 0.74 and N = 4

PART-C

71. Differential pulse polarography (DPP) is more sensitive than D.C. Polarography (DCP). Consider following reasons for it
 (A) non-faradic current is less in DPP in comparison to DCP
 (B) non-faradic current is more in DPP in comparison to DCP
 (c) polarogram of DPP is of different shape than that of DCP

Correct reason(s) is/are

- (a) A and C (b) B and C (c) B only (d) A only
72. Considering the following parameters with reference to the fluorescence of a solution:
 (A) molar absorptivity of fluorescent molecule
 (B) intensity of light source used excitation
 (C) dissolved oxygen

The correct answer for the enhancement of fluorescence with the increase in these parameters is/are

- (a) A and B (b) B and C (c) A and C (d) C only
73. The geometric cross section of ^{125}Sn (in barn) is nearly
 (a) 1.33 (b) 1.53 (c) 1.73 (d) 1.93
74. Match column A (coupling reactions) with column B (reagents)

Column-A

- (1) Suzuki coupling
 (2) Heck coupling
 (3) Sonagashira coupling
 (4) Negeshi coupling

Column-B

- (I) $\text{H}_2\text{C}=\text{CHCO}_2\text{CH}_3$
 (II) $\text{RB}(\text{OH})_2$
 (III) $\text{PhCO}(\text{CH}_2)_3\text{Znl}$
 (IV) $\text{CH}\equiv\text{CR}$
 (V) SnR_4

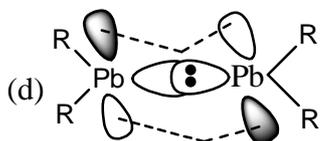
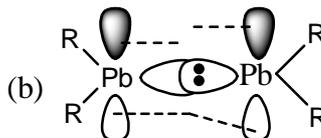
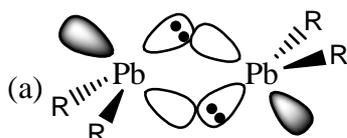
The correct match is

- (a) 1-II, 2-I, 3-IV, 4-III (b) 1-I, 2-V, 3-III, 4-IV
 (c) 1-IV, 2-III, 3-II, 4-I (d) 1-II, 2-III, 3-IV, 4-V
75. The oxoacid of phosphorus having P atoms in +4, +3, and +4 oxidation states respectively, is
 (a) $\text{H}_5\text{P}_3\text{O}_{10}$ (b) $\text{H}_5\text{P}_3\text{O}_7$ (c) $\text{H}_5\text{P}_3\text{O}_8$ (d) $\text{H}_5\text{P}_3\text{O}_9$

76. The geometries of $[\text{Br}_3]^+$ and $[\text{I}_5]^+$, respectively, are
 (a) trigonal and tetrahedral (b) tetrahedral and trigonal bipyramidal
 (c) tetrahedral and tetrahedral (d) linear and trigonal pyramidal

77. According to Wade's theory the anion $[\text{B}_{12}\text{H}_{12}]^{2-}$ adopts
 (a) closo-structure (b) arachno-structure (c) hypo-structure (d) nido-structure

78. Considering the inert pair effect on lead, the most probable structure of $\text{PbR}_2[\text{R} = 2, 6\text{-C}_6\text{H}_3(2, 6\text{-Pr}_2\text{C}_6\text{H}_3)_2]$ is





79. The reaction of SbCl_3 with 3 equivalents of EtMgBr yields compound X. Two equivalents of SbI_3 react with one equivalent of X to give Y. In the solid state, Y has a 1D-polymeric structure in which each Sb is in a square pyramidal environment. Compounds X and Y respectively, are

- (a) SbEt_3 and $[\text{Sb}(\text{Et})\text{I}_2]_n$ (b) $\text{Sb}(\text{Et}_2)\text{Cl}$ and $[\text{Sb}(\text{Et}_2)\text{Cl}]_n$
 (c) SbEt_3 and $[\text{SbEt}_2\text{Br}_2]_n$ (d) $\text{Sb}(\text{Et})\text{Br}_2$ and $[\text{SbEt}(\text{I})(\text{Br})]_n$

80. Match the complexes given in column I with the electronic transitions (mainly responsible for their colours) listed in column II

Column-I

(I) $\text{Fe}(\text{II})$ -protoporphyrin IX

(II) $[\text{Mn}(\text{H}_2\text{O})_6]\text{Cl}_2$

(III) $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_2$

Column-II

(A) $\pi \rightarrow \pi^*$

(B) spin allowed $d \rightarrow d$

(C) spin forbidden $d \rightarrow d$

(D) $M \rightarrow L$ charge transfer

The correct answer is

(a) I-A, II-C and III-B

(c) I-A, II-C and III-D

(b) I-D, II-B and III-C

(d) I-A, II-B and III-C

81. The following statements are given regarding the agostic interaction $\text{C}-\text{H} \cdots \text{Ir}$ observed in $[\text{Ir}(\text{Ph}_3\text{P})_3\text{Cl}]$.

(A) Upfield shift of C-H proton in ^1H NMR spectrum

(B) Increased acid character of C-H

(C) $\nu_{\text{C-H}}$ in IR spectrum shifts to higher wavenumber

The correct answer is/are

(a) A and C

(b) B and C

(c) A and B

(d) C only

82. Amongst the following (A) $[\text{Mn}(\eta^5-\text{Cp})(\text{CO})_3]$, (B) $[\text{Os}(\eta^5-\text{Cp})_2]$, (C) $[\text{Ru}(\eta^5-\text{Cp})_2]$ and

(D) $[\text{Fe}(\eta^5-\text{Cp})_2]$, the compounds with most shielded and deshielded Cp protons respectively, are

(a) D and A

(b) D and B

(c) C and A

(d) C and B

83. Total number of vertices in metal clusters $[\text{Ru}_6(\text{C})(\text{CO})_{17}]$, $[\text{Os}_5(\text{C})(\text{CO})_{15}]$ and $[\text{Ru}_5(\text{C})(\text{CO})_{16}]$ are 6, 5 and 5, respectively. The predicted structures of these complexes, respectively are

(a) closo, nido and nido

(b) closo, nido and arachno

(c) arachno, closo and nido

(d) arachno, nido and closo

84. Among the complexes, (A) $\text{K}_4[\text{Cr}(\text{CN})_6]$, (B) $\text{K}_4[\text{Fe}(\text{CN})_6]$, (C) $\text{K}_3[\text{Co}(\text{CN})_6]$ and $\text{K}_4[\text{Mn}(\text{CN})_6]$, Jahn-Teller distortion is expected in

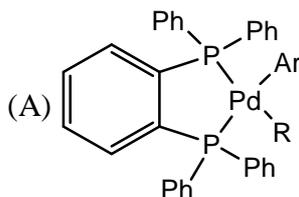
(a) A, B and C

(b) B, C and D

(c) A and D

(d) B and C

85. The reductive elimination of Ar-R (coupled product) from A is facile when

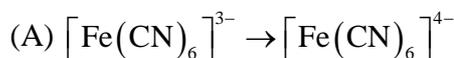


- (a) $R = \text{CH}_3$ (b) $R = \text{CH}_2\text{Ph}$ (c) $R = \text{CH}_2\text{COPh}$ (d) $R = \text{CH}_2\text{CF}_3$
86. The total number of metal ions and the number of coordinated imidazole units of histidine in the active site of oxy-hemocyanin, respectively, are
- (a) 2Cu^{2+} and 6 (b) 2Fe^{2+} and 5 (c) 2Cu^+ and 6 (d) Fe^{2+} and 3
87. Match the action of H_2O_2 in aqueous medium given in column A with the oxidation/reduction listed in column B

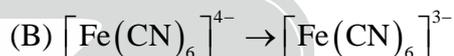
A : action of H_2O_2

B : type of reaction

(I) Oxidation in acid



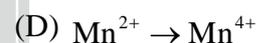
(II) Oxidation in base



(III) Reduction in acid

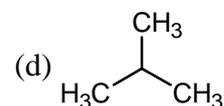
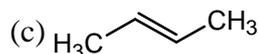
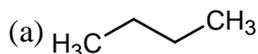
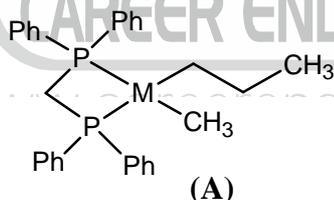


(IV) Reduction in base

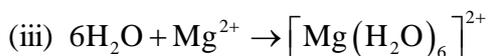
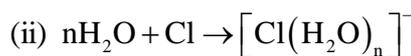
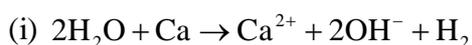


The correct answer is

- (a) I-A, II-B, III-C, IV-D (b) I-B, II-D, III-C, IV-A
- (c) I-C, II-D, III-B, IV-A (d) I-D, II-A, III-C, IV-B
88. The reduced form of a metal ion M in a complex is NMR active. On oxidation, the complex gives an EPR signal with $g_{\parallel} \approx 2.2$ and $g_{\perp} \approx 2.0$. Mossbauer spectroscopy cannot characterize the metal complex. The M is
- (a) Zn (b) Sn (c) Cu (d) Fe
89. The least probable product from A on reductive elimination is



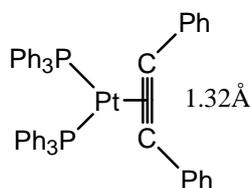
90. Water plays different roles in the following reactions.



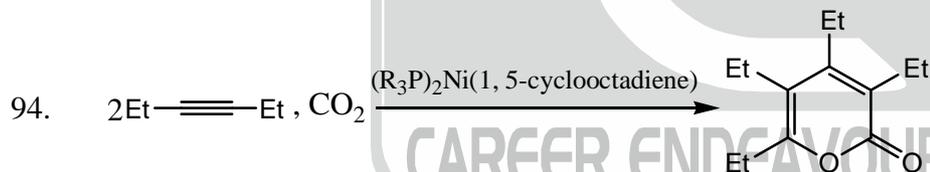
The correct role of water in each reaction is,

- (a) (i) oxidant, (ii) acid, (iii) base and (iv) reductant
- (b) (i) oxidant, (ii) base, (iii) acid and (iv) reductant
- (c) (i) acid, (ii) oxidant, (iii) reductant and (iv) base
- (d) (i) base, (ii) reductant, (iii) oxidant and (iv) base

91. With respect to σ and π bonding in $\text{Pt}-\text{C}\equiv\text{C}$ in the structure given below, which of the following represent the correct bonding.



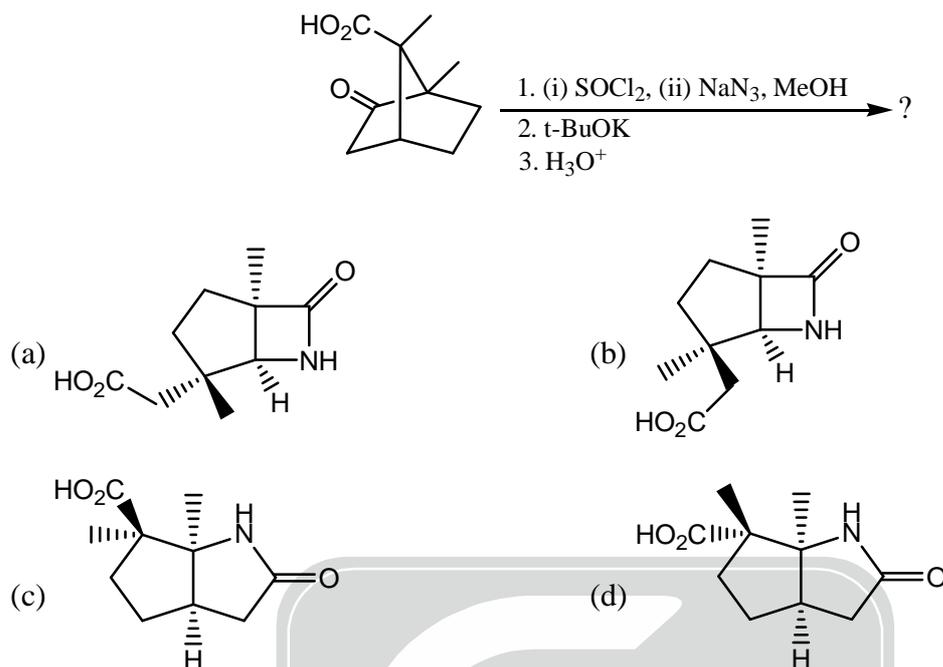
- (a) $M(\sigma) \rightarrow L(\sigma)$ and $M(\pi) \rightarrow L(\pi^*)$ (b) $L(\sigma) \rightarrow M(\pi)$ and $L(\pi) \rightarrow M(\pi)$
 (c) $L(\pi) \rightarrow M(\pi)$ and $L(\sigma) \rightarrow M(\pi)$ (d) $L(\pi) \rightarrow M(\sigma)$ and $M(\pi) \rightarrow L(\pi^*)$
92. The complex $[\text{Fe}(\text{phen})_2(\text{NCS})_2]$ (phen = 1,10-phenanthroline) shows spin cross-over behaviour. CFSE and μ_{eff} at 250 and 150K, respectively are
 (a) $0.4\Delta_0, 4.90 \text{ BM}$ and $2.4\Delta_0, 0.00 \text{ BM}$ (b) $2.4\Delta_0, 2.90 \text{ BM}$ and $0.4\Delta_0, 1.77 \text{ BM}$
 (c) $2.4\Delta_0, 0.00 \text{ BM}$ and $0.4\Delta_0, 4.90 \text{ BM}$ (d) $1.2\Delta_0, 4.90 \text{ BM}$ and $2.4\Delta_0, 0.00 \text{ BM}$
93. Consider the following statements with respect to uranium
 (A) UO_2^+ disproportionates more easily than UO_2^{2+}
 (B) U_3O_8 is its most stable oxide of U
 (C) Coordination number of U in $[\text{UO}_2(\text{NO}_3)_2(\text{H}_2\text{O})_2] \cdot 4\text{H}_2\text{O}$ is six.
 (D) UO_2^{2+} is linear
 The correct set of statements is
 (a) A, B and D (b) A, C and D (c) B, C and D (d) A, B and C



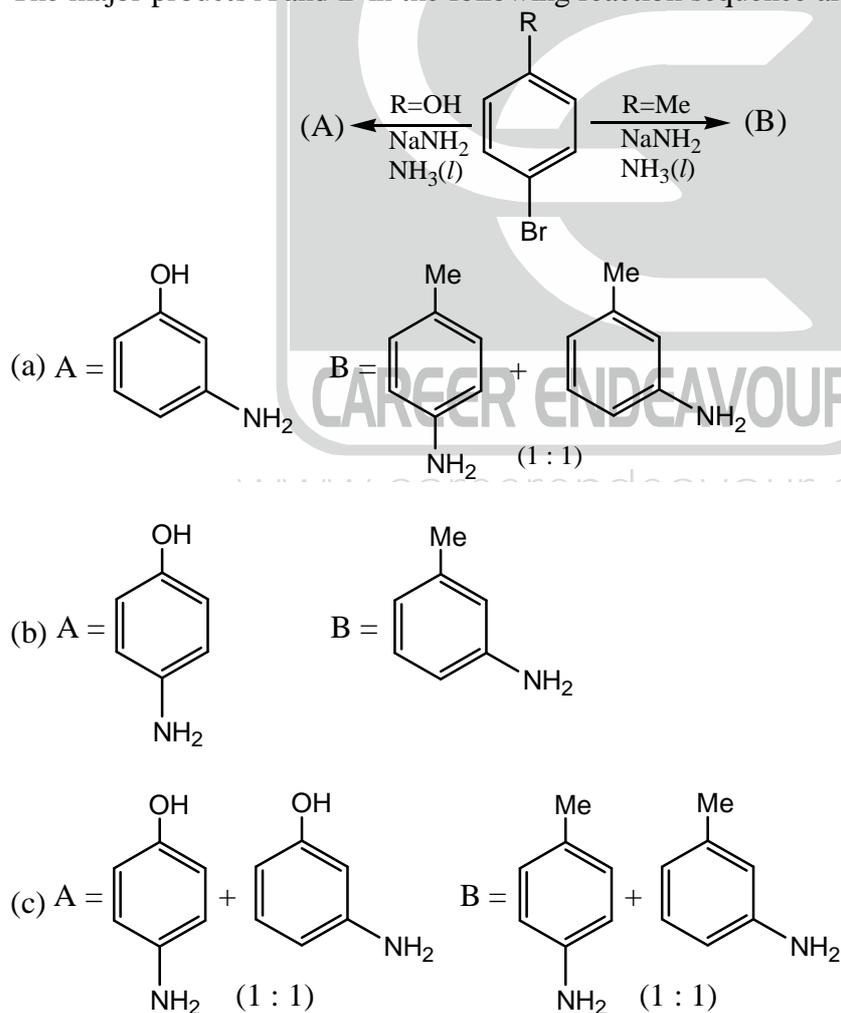
For the above conversion, which of the following statements are correct?

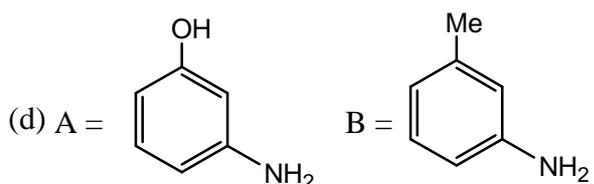
- (A) CO_2 combines with $\text{Ni}(\text{PR}_3)_2(1,5\text{-cyclooctadiene})$
 (B) Insertion of CO_2 occurs
 (C) Insertion of $\text{Et}-\text{C}\equiv\text{C}-\text{Et}$ takes place
 The correct answer is
 (a) A and B (b) B and C (c) C and A (d) A, B and C
95. Consider the following statements for $(\text{NH}_4)_2[\text{Ce}(\text{NO}_3)_6](Z)$
 (A) Coordination number of Ce is 12
 (B) Z is paramagnetic
 (C) Z is an oxidising agent
 (D) Reaction of Ph_3PO with Z gives a complex having coordination number 10 for Ce.
 The correct statements are
 (a) A, B and C (b) B, A and D (c) B, C and D (d) A, C and D

96. The major product formed in the following reaction sequence is

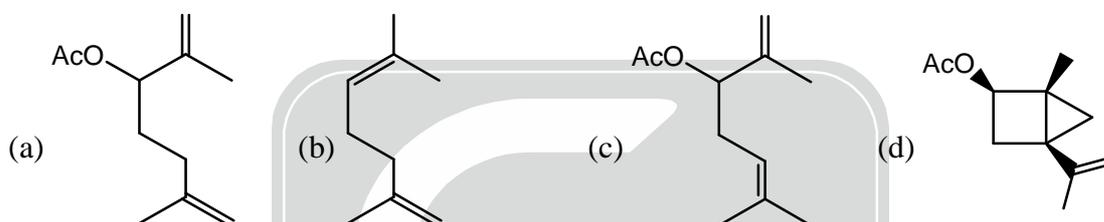
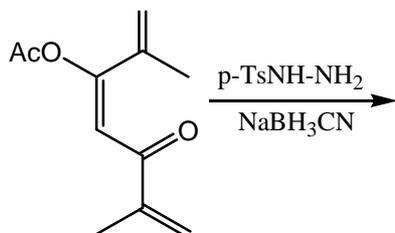


97. The major products A and B in the following reaction sequence are

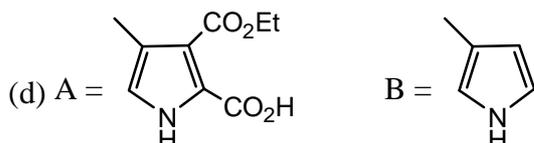
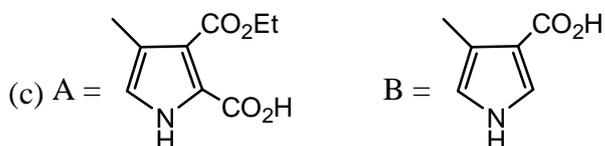
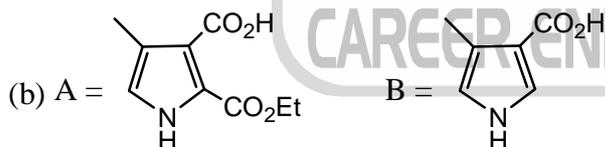
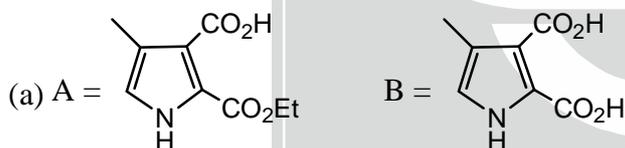
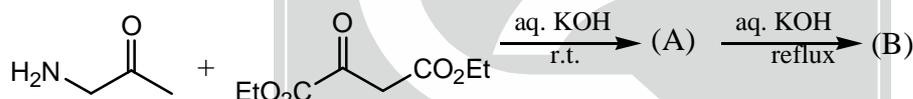




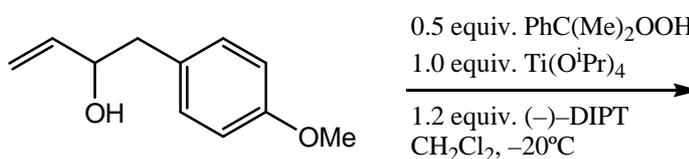
98. The major product formed in the following reaction is

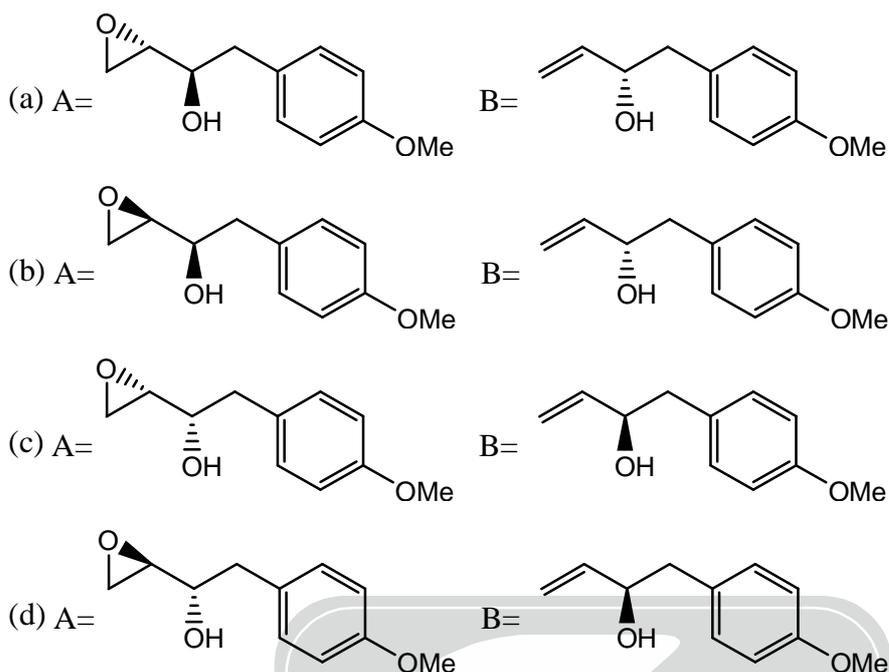


99. The major products A and B in the reactions sequence are

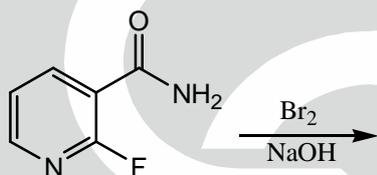


100. The major products formed in the following reaction are



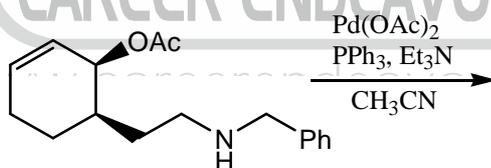


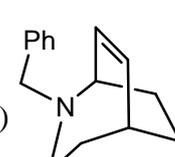
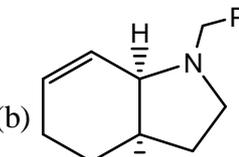
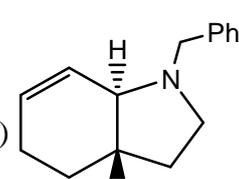
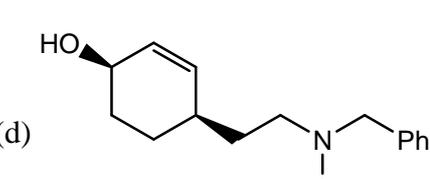
101. The correct statement about the following reaction is



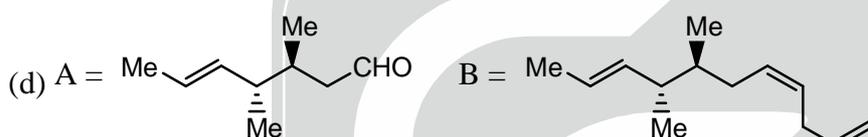
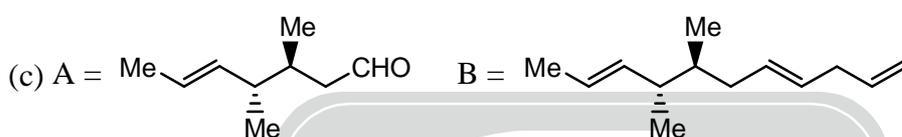
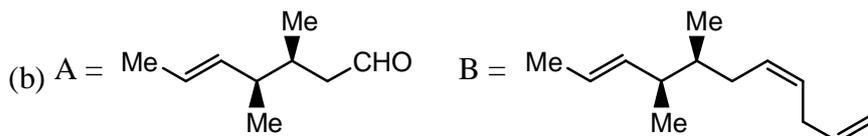
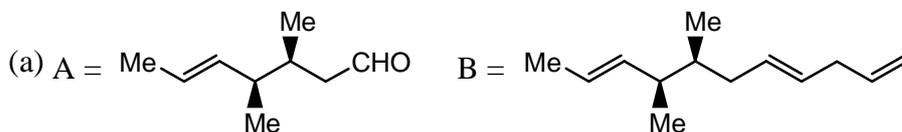
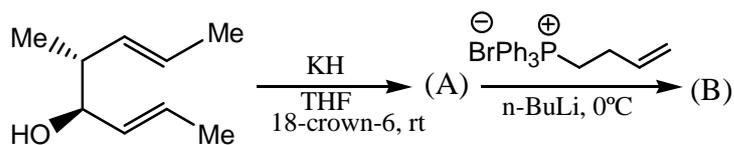
- (a) The product is 2-fluoropyridin-3-amine and reaction involves nitrene intermediate
 (b) The product is 2-fluoropyridin-3-amine and reaction involves radical intermediate
 (c) The product is 2-hydroxynicotinamide and reaction involves benzyne-like intermediate
 (d) The product is 2-hydroxynicotinamide and reaction involves addition-elimination mechanism

102. The major product formed in the following reaction is

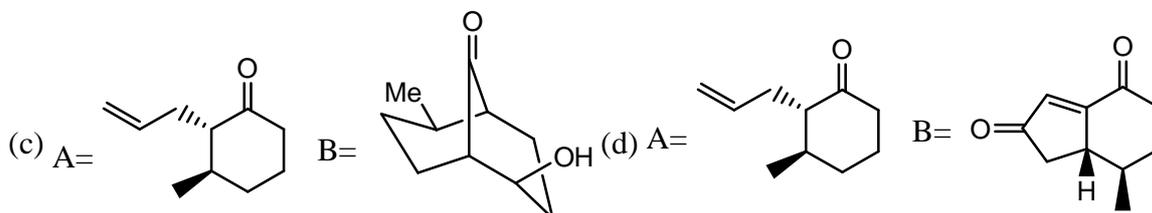
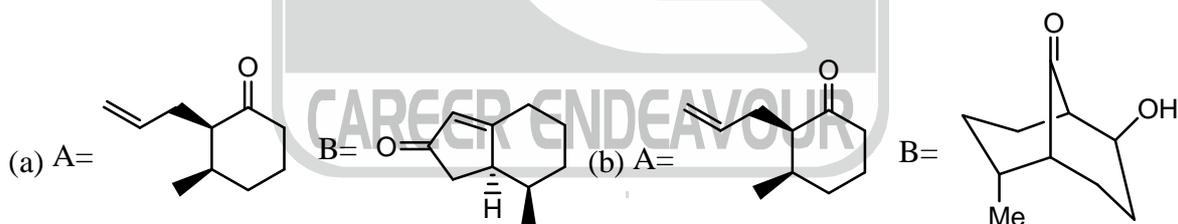
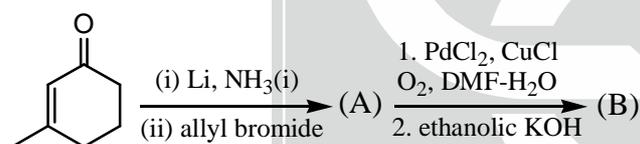


- (a) 
- (b) 
- (c) 
- (d) 

103. The major products A and B formed in the following reactions are



104. The major products A and B formed in the following reactions are



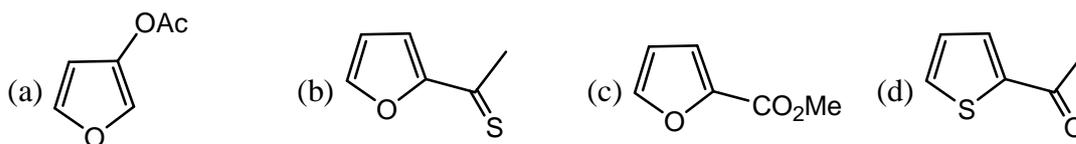
105. An organic compounds shows following spectral data:

IR (cm^{-1}): 1680

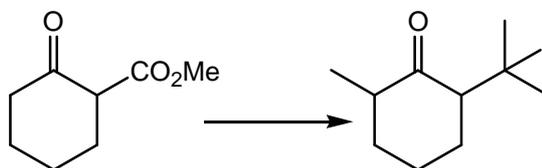
$^1\text{H NMR}$ (CDCl_3): δ 7.66(m, 1H), 7.60 (m, 1H), 7.10(m, 1H), 2.50(s, 3H)

$^{13}\text{C NMR}$ (CDCl_3): δ 190, 144, 134, 132, 128, 28 m/z (EI) : 126 (M^+ , 100%), 128 ($\text{M}^+ + 2$, 4.9%)

The structure of the compound is

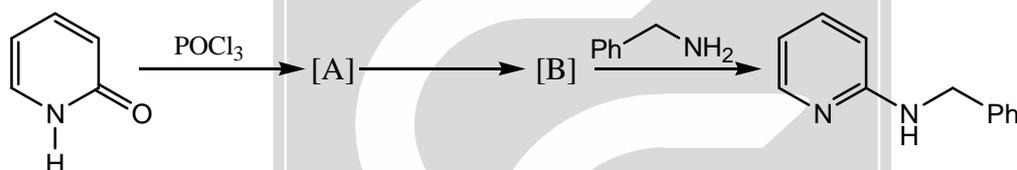


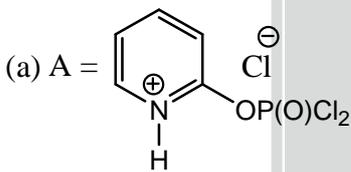
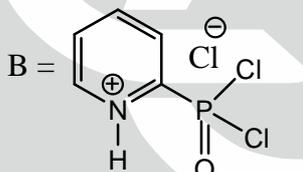
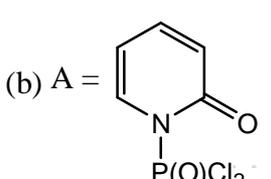
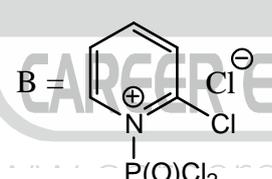
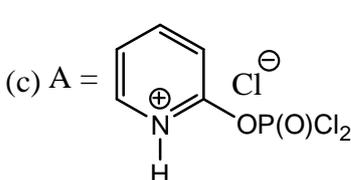
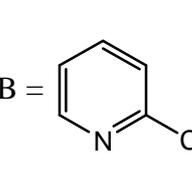
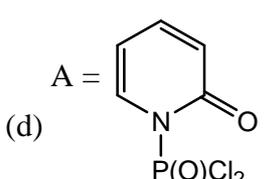
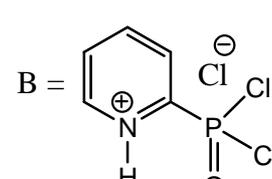
106. The correct set of reagents to effect the following transformation is



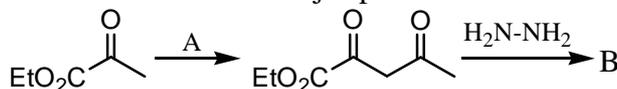
- (a) (I) (i) NaOMe, MeI; (ii) NaCl, wet DMSO, 160°C; (II) (i) LDA, -78°C, TMSCl; (ii) t-BuCl, TiCl₄, 50°C
 (b) (I) (i) NaOMe, MeI; (ii) aq. NaOH then HCl, heat; (II) (i) Et₃N, TMSCl, rt; (ii) t-BuCl, TiCl₄, 50°C
 (c) (i) LDA, t-BuCl, (ii) LDA, MeI; (iii) aq. NaOH then HCl, heat
 (d) (I) (i) NaCl, wet DMSO, 160°C; (ii) NaH, t-BuCl; (II) (i) morpholine, H⁺; (ii) MeI then H₃O⁺.

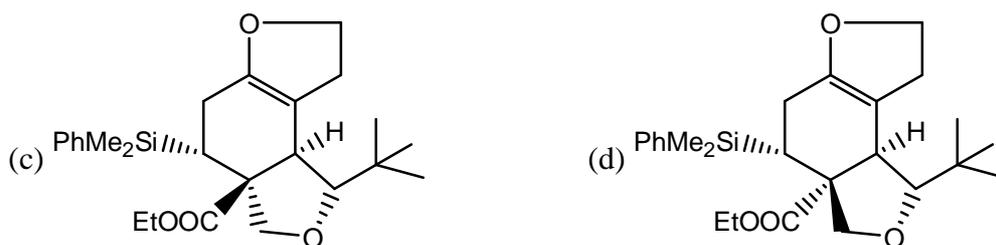
107. The correct structures of the intermediates [A] and [B] in the following reactions are



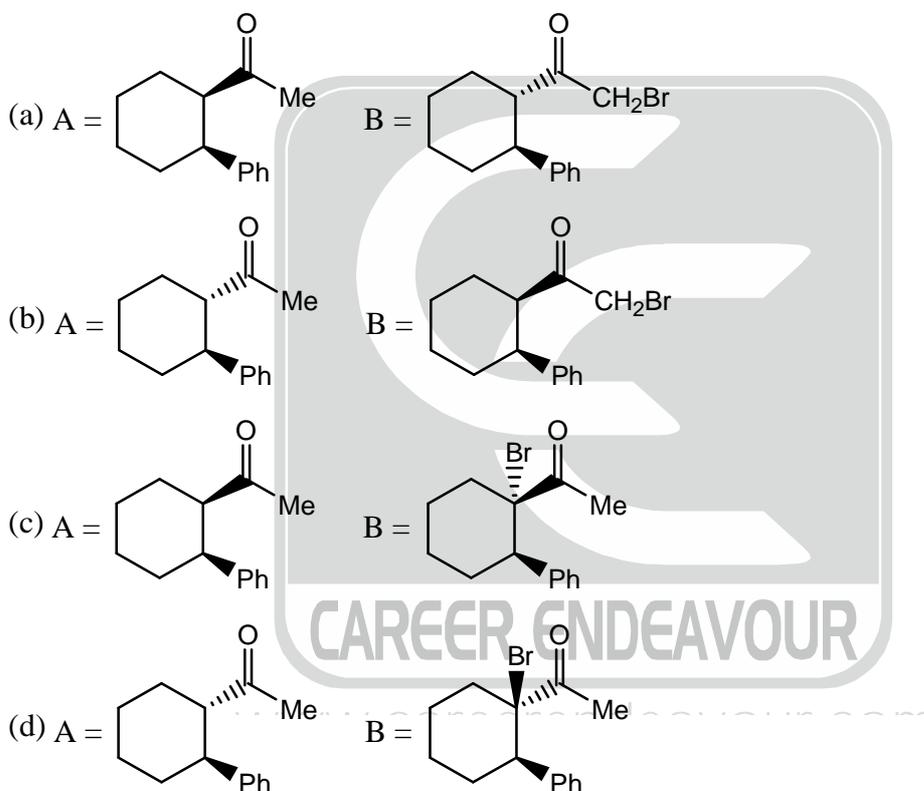
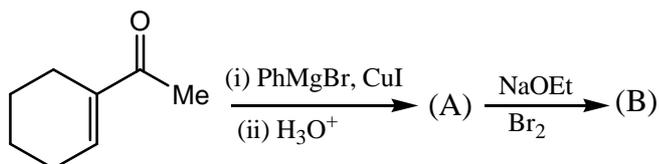
- (a) A =  B = 
 (b) A =  B = 
 (c) A =  B = 
 (d) A =  B = 

108. The correct reagent combination A and the major product B in the following reaction sequence are

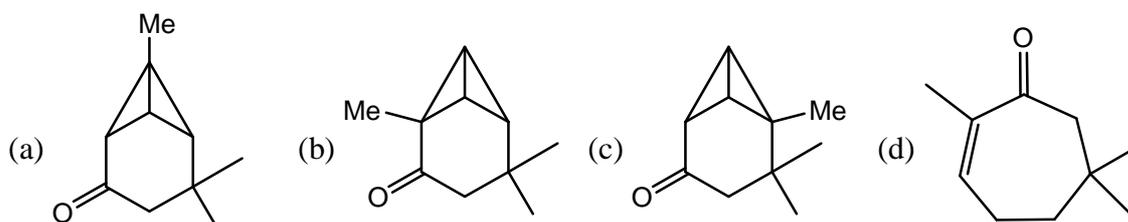
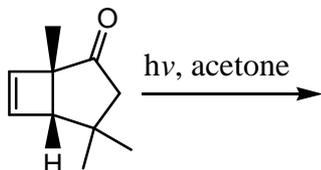




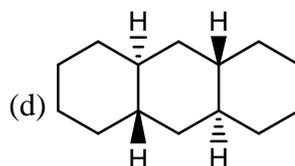
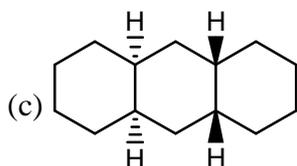
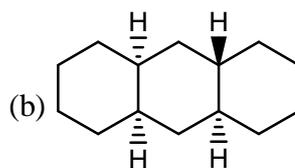
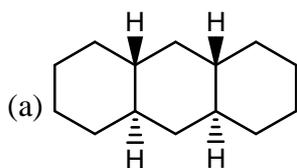
111. The major products A and B in the following synthetic sequence are



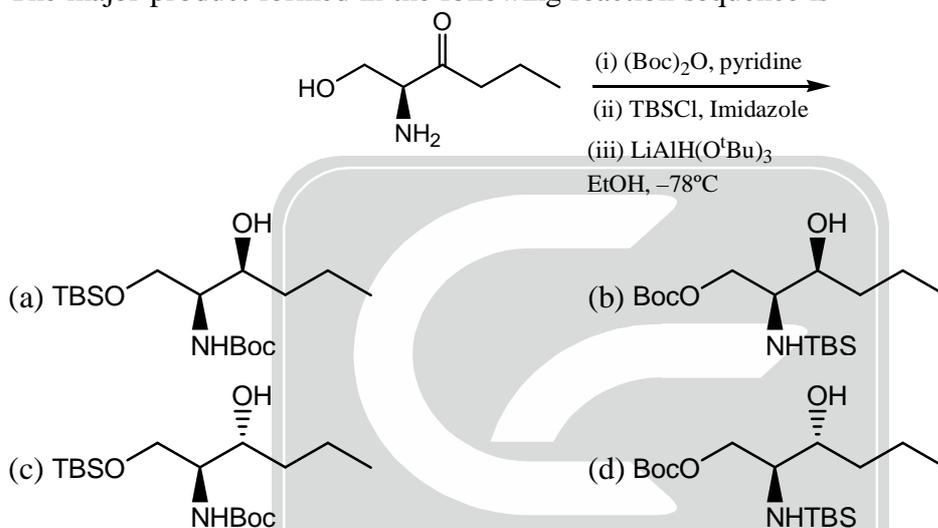
112. The major product formed in the following reaction is



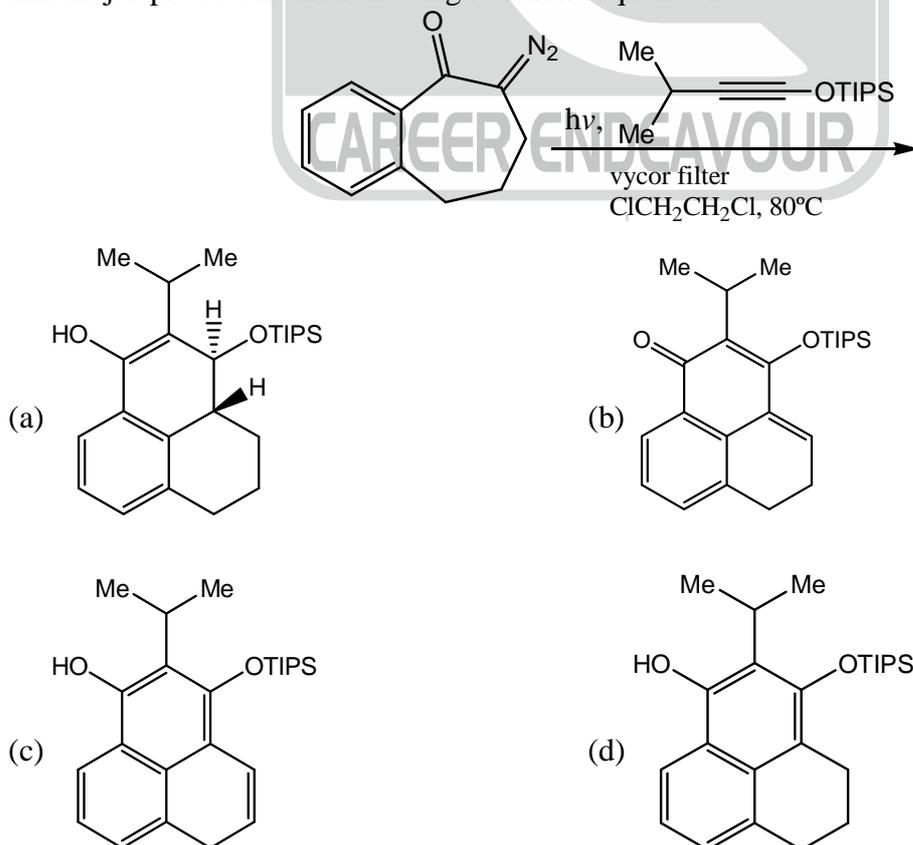
113. The hydrocarbon among the following having conformationally locked chair-boat-chair form is



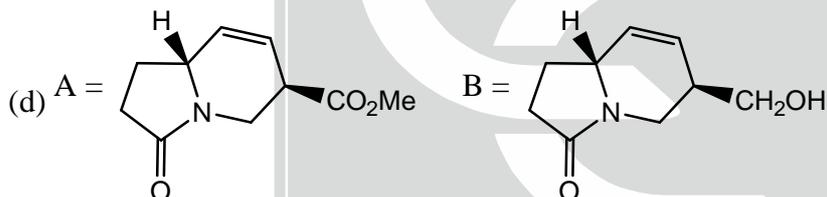
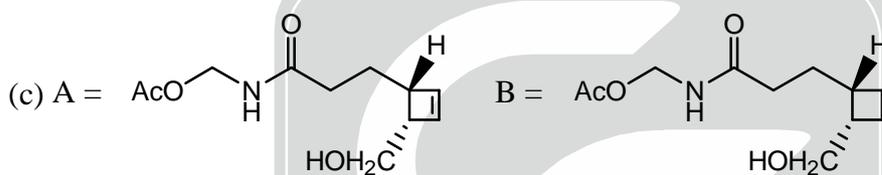
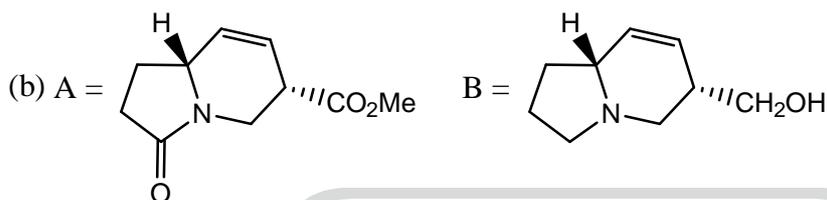
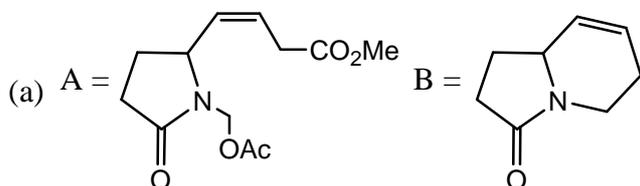
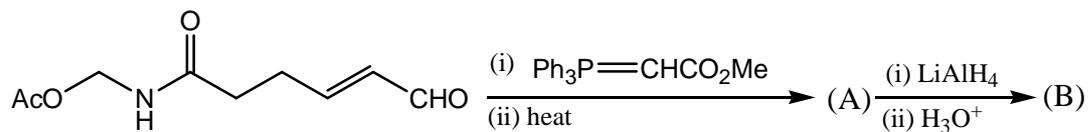
114. The major product formed in the following reaction sequence is



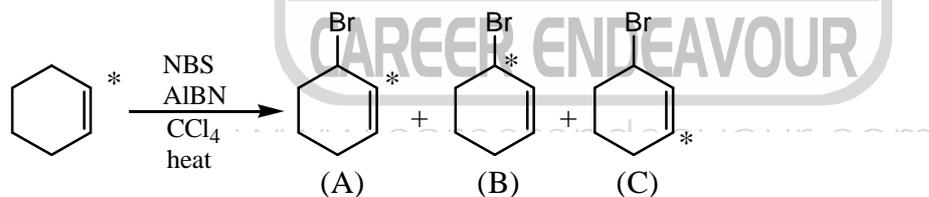
115. The major product in the following reaction sequence is



116. Structures of A and B in the following synthetic sequence are



117. In the following reaction, the ratio of A : B : C is (*indicates labelled carbon)



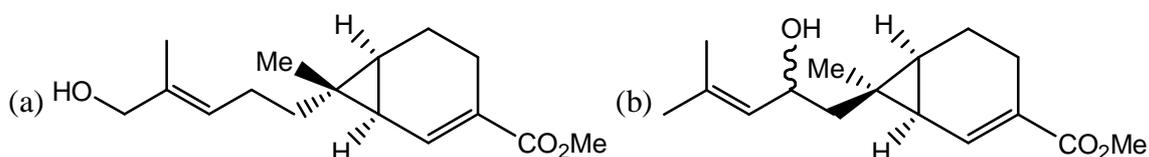
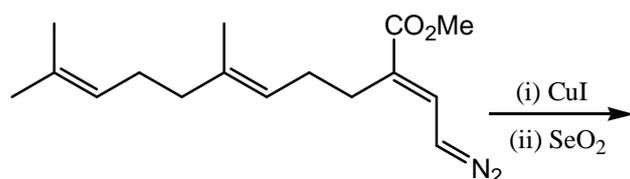
(a) 1 : 1 : 1

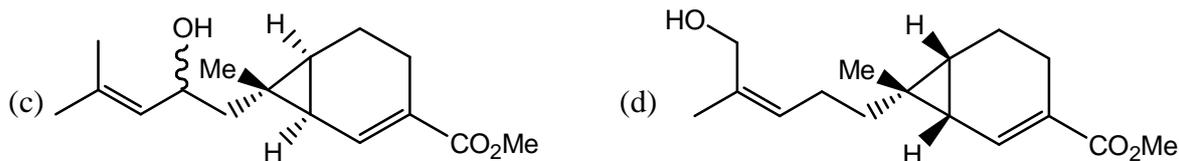
(b) 1 : 2 : 1

(c) 2 : 1 : 1

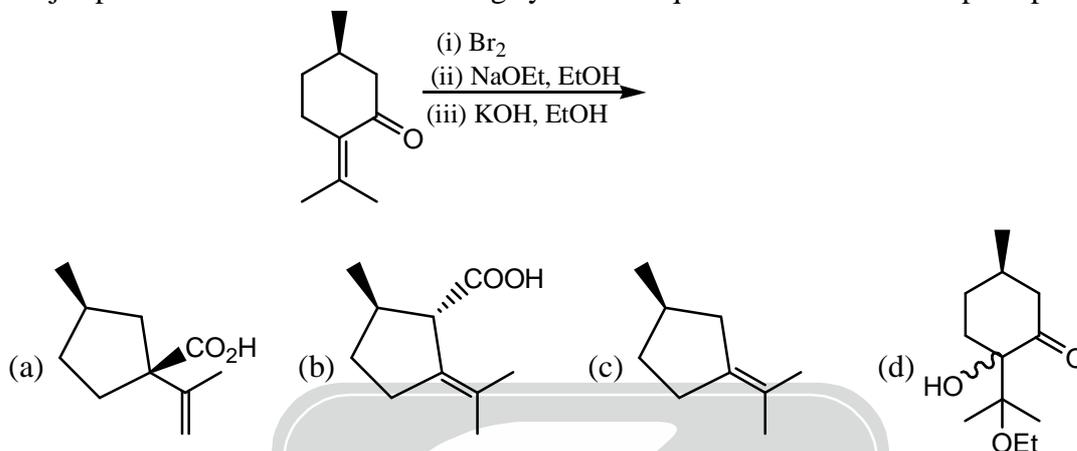
(d) 3 : 2 : 1

118. Structure of the major product in the following synthetic sequence is

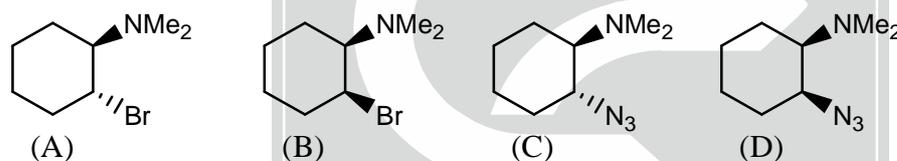




119. Major product formed in the following synthetic sequence on the monoterpene pulegone is



120. Optically pure isomers A and B were heated with NaN_3 in DMF. The correct statement from the following is



- (a) A gives optically pure D and B gives optically pure C
 (b) A gives racemic mixture of C and B gives optically pure C
 (c) A gives optically pure C and B gives racemic C
 (d) A gives optically pure D and B gives racemic D

121. A molecular orbital of a diatomic molecule changes sign when it is rotated by 180° around the molecular axis. This orbital is

- (a) σ (b) π (c) δ (d) ϕ

122. IR active normal modes of methane belong to the irreducible representation:

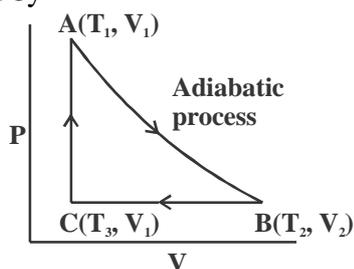
T_d	E	$8C_3$	$3C_2$	$6S_4$	$6\sigma_d$	
A_1	1	1	1	1	1	$x^2 + y^2 + z^2$
A_2	1	1	1	-1	-1	
E	2	-1	2	0	0	$2z^2 - x^2 - y^2, x^2 - y^2$
T_1	3	0	-1	1	-1	R_x, R_y, R_z
T_2	3	0	-1	-1	1	x, y, z, xy, yz, zx

- (a) $E + A_1$ (b) $E + A_2$ (c) T_1 (d) T_2

123. The symmetric rotor among the following is

- (a) CH_4 (b) CH_3Cl (c) CH_2Cl_2 (d) CCl_4

124. The nuclear g-factors of ^1H and ^{14}N are 5.6 and 0.40 respectively. If the magnetic field in an NMR spectrometer is set such that the proton resonates at 700 MHz, the ^{14}N nucleus would resonate at
 (a) 1750 MHz (b) 700 MHz (c) 125 MHz (d) 50 MHz
125. The spectroscopic technique, by which the ground state dissociation energies of diatomic molecules can be estimated, is
 (a) microwave spectroscopy (b) infrared spectroscopy
 (c) UV-visible absorption spectroscopy (d) X-ray spectroscopy
126. The term symbol for the first excited state of Be with the electronic configuration $1s^2 2s^1 3s^1$ is
 (a) 3S_1 (b) 3S_0 (c) 1S_0 (d) $^2S_{1/2}$
127. Which of the following statement is INCORRECT?
 (a) A Slater determinant is an antisymmetrized wavefunction
 (b) Electronic wavefunction should be represented by Slater determinants
 (c) A Slater determinant always corresponds to a particular spin state
 (d) A Slater determinant obeys the Pauli exclusion principle
128. Compare the difference of energies of the first excited and ground states of a particle confined in (i) a 1-d box (Δ_1), (ii) a 2-d square box (Δ_2) and (iii) a 3-d cubic box (Δ_3). Assume the length of each of the boxes is the same. The correct relation between the energy differences Δ_1 , Δ_2 and Δ_3 for the three states is
 (a) $\Delta_1 > \Delta_2 > \Delta_3$ (b) $\Delta_1 = \Delta_2 = \Delta_3$ (c) $\Delta_3 > \Delta_2 > \Delta_1$ (d) $\Delta_3 > \Delta_1 > \Delta_2$
129. The correct statement about both the average value of position ($\langle x \rangle$) and momentum ($\langle p \rangle$) of a 1-d harmonic oscillator wavefunction is
 (a) $\langle x \rangle \neq 0$ and $\langle p \rangle \neq 0$ (b) $\langle x \rangle = 0$ but $\langle p \rangle \neq 0$
 (c) $\langle x \rangle = 0$ and $\langle p \rangle = 0$ (d) $\langle x \rangle \neq 0$ but $\langle p \rangle = 0$
130. The value of the commutator $[x, [x, p_x]]$ is
 (a) $i\hbar x$ (b) $-i\hbar$ (c) $i\hbar$ (d) 0
131. The equilibrium constants for the reactions $\text{CH}_4(\text{g}) + 2\text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + 4\text{H}_2(\text{g})$ and $\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + \text{H}_2(\text{g})$ are K_1 and K_2 , respectively. The equilibrium constant for the reaction $\text{CH}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}(\text{g}) + 3\text{H}_2(\text{g})$ is
 (a) $K_1 \cdot K_2$ (b) $K_1 - K_2$ (c) K_1 / K_2 (d) $K_2 - K_1$
132. Consider the progress of a system along the path shown in the figure $\Delta S(\text{B} \rightarrow \text{C})$ for one mole of an ideal gas is then given by

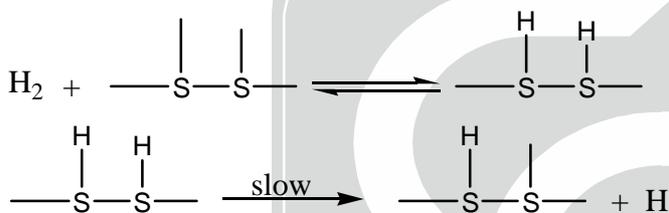


- (a) $R \ln \frac{T_1}{T_3}$ (b) $R \ln \frac{T_3}{T_1}$ (c) $R \ln \frac{V_2}{V_1}$ (d) $R \ln \frac{V_1}{V_2}$

133. A thermodynamic equation that relates the chemical potential to the composition of a mixture is known as
 (a) Gibb's-Helmholtz equation (b) Gibbs-Duhem equation
 (c) Joule-Thomson equation (d) Debye-Huckel equation
134. According to transition state theory, the temperature-dependence of pre-exponential factor (A) for a reaction between a linear and a non-linear molecule, that forms products through a non-linear transition state, is given by
 (a) T (b) T² (c) T⁻² (d) T^{-1.5}
135. For a given ionic strength, (I) rate of reaction is given by

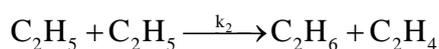
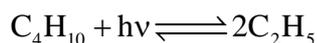
$\log \frac{k}{k_0} = -4 \times 0.51(I)^{1/2}$. Which of the following reactions follows the above equation?

- (a) S₂O₈²⁻ + I⁻ (b) Co(NH₃)₅ Br²⁺ + OH⁻
 (c) CH₃COOC₂H₅ + OH⁻ (d) H⁺ + Br⁻ + H₂O₂
136. For a reaction on a surface



At low pressure of H₂, the rate is proportional to

- (a) [H₂] (b) 1/[H₂] (c) [H₂]^{1/2} (d) 1/[H₂]^{1/2}
137. The temperature-dependence of an electrochemical cell potential is
 (a) $\frac{\Delta G}{nFT}$ (b) $\frac{\Delta H}{nF}$ (c) $\frac{\Delta S}{nF}$ (d) $\frac{\Delta S}{nFT}$
138. The single-particle partition function (f) for a certain system has the form $f = AVe^{BT}$. The average energy per particle will then be (k is the Boltzmann constant)
 (a) BkT (b) BkT² (c) kT/B (d) kT/B²
139. The indistinguishability correction in the Boltzmann formulation is incorporated in the following way : (N = total number of particles, f = single-particle partition function)
 (a) replace by f/N! (b) replace f^N by f^N/N!
 (c) replace f by f/ln(N!) (d) replace by f^N by f^N/ln(N!)
140. In a photochemical reaction, radicals are formed according to the equation



If I is the intensity of light absorbed, the rate of the overall reaction is proportional to

- (a) I (b) I^{1/2} (c) I[C₄H₁₀] (d) I^{1/2}[C₄H₁₀]^{1/2}

141. Conductometric titration of a strong acid with a strong alkali (MOH) shows linear fall of conductance up to neutralization point because of
- (a) formation of water
 - (b) increase in alkali concentration
 - (c) faster moving H^+ being replaced by slower moving M^+ .
 - (d) neutralization of acid.
142. Find the probability of the link in polymers where average values of links are (A) 10, (B) 50 and (C) 100
- (a) (A) 0.99, (B) 0.98, (C) 0.90
 - (b) (A) 0.98, (B) 0.90, (C) 0.99
 - (c) (A) 0.90, (B) 0.98, (C) 0.99
 - (d) (A) 0.90, (B) 0.99, (C) 0.98
143. The stability of lyophobic colloid is the consequence of
- (a) van der waals attraction among the solute-solvent adducts
 - (b) Brownian motion of the colloidal particles
 - (c) insolubility of colloidal particles in solvent
 - (d) electrostatic repulsion among double-layered colloidal particles
144. In a conductometric experiment for estimation of acid dissociation constant of acetic acid, the following values were obtained in four sets of measurements.
- 1.71×10^{-5} , 1.77×10^{-5} , 1.79×10^{-5} and 1.73×10^{-5}
- The standard deviation of the data would be in the range of
- (a) $0.010 \times 10^{-5} - 0.019 \times 10^{-5}$
 - (b) $0.020 \times 10^{-5} - 0.029 \times 10^{-5}$
 - (c) $0.030 \times 10^{-5} - 0.039 \times 10^{-5}$
 - (d) $0.040 \times 10^{-5} - 0.049 \times 10^{-5}$
145. Silver crystallizes in face-centered cubic structure. The 2nd order diffraction angle of a beam of X-ray ($\lambda = 1 \text{ \AA}$) of (111) plane of the crystal is 30° . Therefore, the unit cell length of the crystal would be
- (a) $a = 3.151 \text{ \AA}$
 - (b) $a = 3.273 \text{ \AA}$
 - (c) $a = 3.034 \text{ \AA}$
 - (d) $a = 3.464 \text{ \AA}$