PART-B

21. The HOMO (highest occupied molecular orbital) to LUMO (lowest unoccupied molecular orbital) electronic transition responsible for the observed colours of halogen molecules (gas) is

(a) $\pi^* \rightarrow \sigma^*$ (b) $\pi^* \rightarrow \pi^*$ (c) $\sigma \rightarrow \sigma^*$ (d) $\pi \rightarrow \sigma^*$

22. In the hydrolysis of *trans*-$\left[\mathrm{Co(en)_2Cl(A)}\right]^+$, if the leaving group is chloride, the formation of *cis* product is the least, when A is

(a) NO_2^- (b) NCS^- (c) Cl^- (d) OH^-

23. The expected number of ^{19}F NMR spectral lines, including satellites, for $\left[XeF_5\right]^-$ is [Abundance of ^{129}Xe (I = ½) = 26%]

(a) two (b) twenty one (c) three (d) one

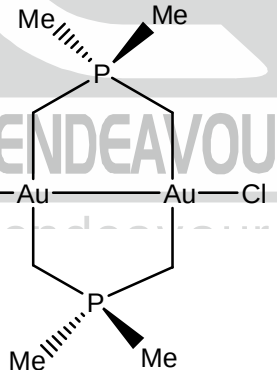
24. The expected H–H–H bond angle in $[H_3]^+$ is

(a) 180º (b) 120º (c) 60º (d) 90º

25. The number of bridging ligand(s) and metal-metal bond(s) present in the complex $\left[\mathrm{Ru_2(\eta^5-Cp)_2(CO)_2(Ph_2PCH_2PPh_2)}\right]$ (obeys 18-electron rule), respectively, are

(a) 0 and 1 (b) 2 and 1 (c) 3 and 1 (d) 1 and 2

26. The oxidation state of gold in the following complex is



(a) 0 (b) 1 (c) 2 (d) 3

27. The rate of alkene coordination to $\left[PtCl_4\right]^{2-}$ is highest for

(a) norbornene (b) ethylene (c) cyclohexene (d) 1-butene

28. The nephelauxetic parameter β is highest for

(a) Br^- (b) Cl^- (c) CN^- (d) F^-

29. The $^2E_g \leftarrow {}^4A_{2g}$ transition in the electronic spectrum of $\left[\mathrm{Cr(NH_3)_6}\right]^{3+}$ occurs nearly at

(a) 650 nm (b) 450 nm (c) 350 nm (d) 200 nm

30. In the catalytic hydration of CO_2 by carbonic anhydrase, CO_2 first interacts with
(a) OH group of the active site of the enzyme and then with zinc
(b) H_2O of the active site of the enzyme and then with zinc
(c) zinc of the active site of the enzyme and then with OH group
(d) zinc of the active site of the enzyme and then with H_2O

31. For the reaction,

$$HX_{(aq)} + H_2O_{(\ell)} \rightleftharpoons H_3O^+_{(aq)} + X^-_{(aq)}$$

the highest value of $\left[X^-\right]_{(aq)}$, when X^- is

(a) OCl^- (b) F^- (c) Cl^- (d) NO_2^-

32. The correct statement for d.c. polarography is
(a) $E_{1/2}$ is concentration dependent
(b) Dropping mercury electrode is a macro electrode
(c) Limiting current is equal to diffusion current
(d) A large excess of supporting electrolyte eliminates migration current.

33. Saturation factor in neutron activation analysis is
(A = induced radioactivity; φ = neutron flux; σ = effective nuclear cross section; N = no. of target atoms; λ = decay constant)

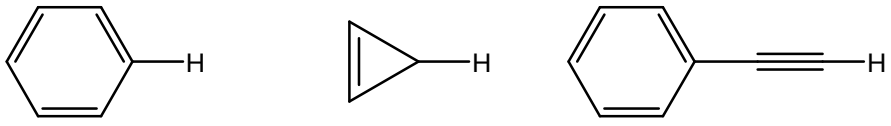
(a) $\frac{A}{\varphi\sigma N}$ (b) $\frac{\varphi\sigma NA}{\lambda}$ (c) $\frac{\lambda}{A\varphi\sigma N}$ (d) $\frac{\varphi\sigma N}{A}$

34. The primary analytical method (not using a reference) is
(a) inductively coupled plasma emission spectrometry
(b) energy dispersive X-ray fluorescence spectrometry
(c) anodic stripping voltammetry
(d) isotopic dilution mass spectrometry

35. The number of inorganic sulphur (or sulphide) atoms present in the metalloprotein active sites of rubredoxin, 2-iron ferredoxin and 4-iron ferredoxin, respectively, are
(a) 0, 2 and 4 (b) 2, 4 and 3 (c) 0, 4 and 2 (d) 0, 2 and 3

36. The metal iodide with metallic lustre and high electrical conductivity is
(a) NaI (b) CdI_2 (c) LaI_2 (d) BiI_3

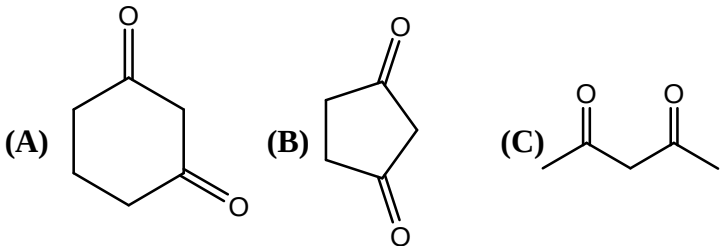
37. The correct order of the bond dissociation energies for the indicated C-H bond in following compounds is



(A) **(B)** **(C)**

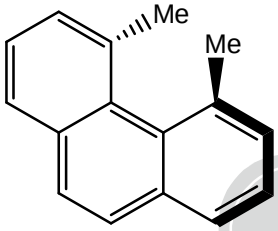
(a) C > B > A (b) A > B > C (c) A > C > B (d) C > A > B

38. The correct order of the acidity for the following compounds is



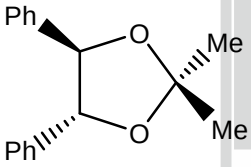
(a) B > C > A (b) C > B > A (c) B > A > C (d) C > A > B

39. The correct statement about the following compound is



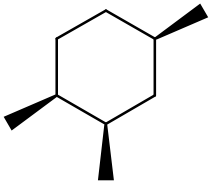
(a) compound is chiral and has P configuration
(b) compound is chiral and has M configuration
(c) compound is achiral as it possesses C_2-axis of symmetry
(d) compound is achiral as it possesses plane of symmetry

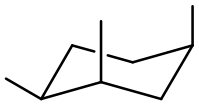
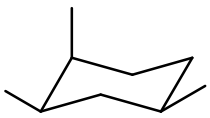
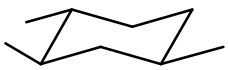
40. Methyl groups in the following compound are



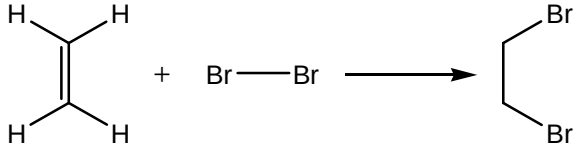
(a) homotopic (b) diastereotopic (c) enantiotopic (d) constitutionally heterotopic

41. Among the structures given below, the most stable conformation for the following compound is



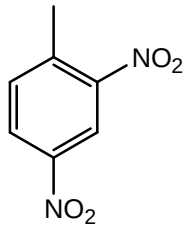
(a)  (b)  (c)  (d) 

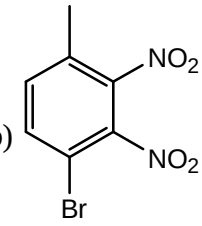
42. Molecular orbital interactions involved in the first step of the following reaction is

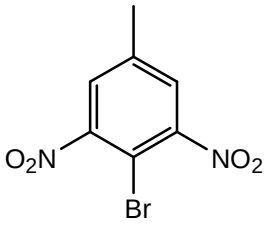


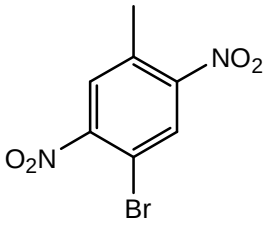
(a) $\pi_{C=C} \rightarrow \sigma^*_{Br-Br}$ (b) $n_{Br} \rightarrow \sigma_{C-C}$ (c) $\pi_{C=C} \rightarrow \sigma_{Br-Br}$ (d) $n_{Br} \rightarrow \pi_{C=C}$

43. The major product formed in the dinitration of 4-bromotoluene is

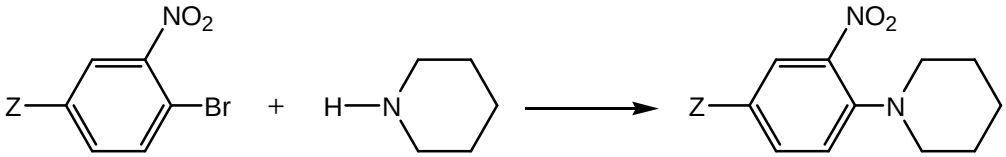
(a) 

(b) 

(c) 

(d) 

44. The correct order of the rate constants for the following series of reactions (Z = CF_3/CH_3/OCH_3) is



(a) $CF_3 > CH_3 > OCH_3$ (b) $CF_3 > OCH_3 > CH_3$
(c) $OCH_3 > CF_3 > CH_3$ (d) $CH_3 > OCH_3 > CF_3$

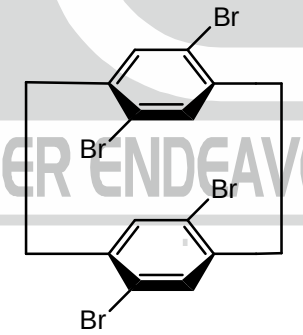
45. ^1H NMR spectrum of a mixture of benzene and acetonitrile shows two singlets of equal integration. The molar ratio of benzene : acetonitrile is
(a) 1 : 1 (b) 2 : 1 (c) 1 : 2 (d) 6 : 1

46. The compound which shows IR frequencies at both 3314 and 2126 cm^{-1} is

(a) $CH_3(CH_2)_4CH_2SH$ (b) $CH_3(CH_2)_4CH_2C\equiv N$

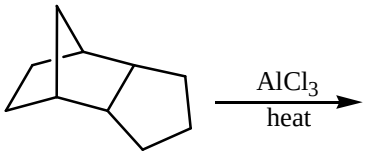
(c) $CH_3(CH_2)_4CH_2C\equiv C-H$ (d) $CH_3(CH_2)_2C\equiv C(CH_2)_2CH_3$

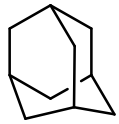
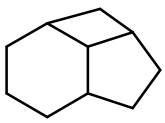
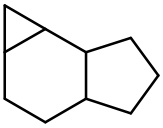
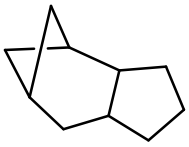
47. Number of signals present in the proton decoupled ^{13}C NMR spectrum of the following compound is



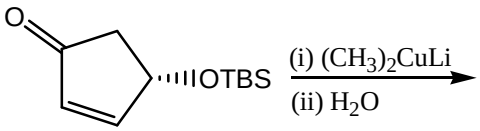
(a) four (b) six (c) eight (d) ten

48. The most stable product formed in the following reaction is

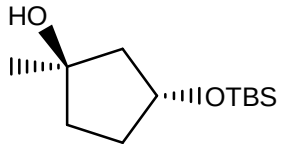


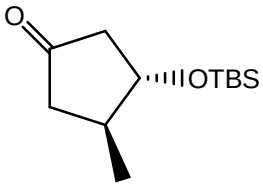
(a)  (b)  (c)  (d) 

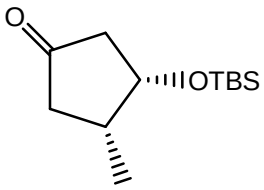
49. The major product in the following reaction is

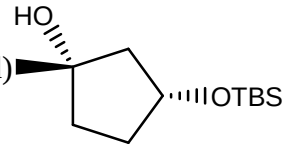


TBS = $Si(CH_3)_2t\text{-}C_4H_9$

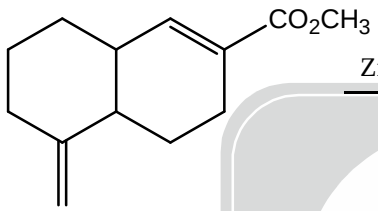
(a) 

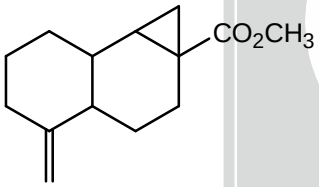
(b) 

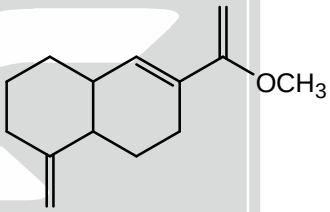
(c) 

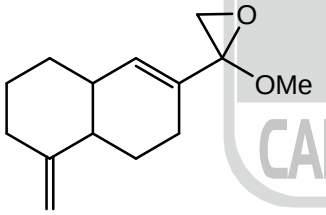
(d) 

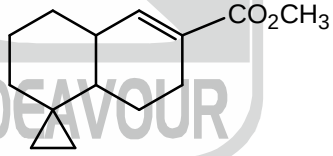
50. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

51. Correct characteristics of the functional groups of adenine in DNA base pair are
(a) N(3) is a hydrogen bond acceptor and C(6)NH_2 is a hydrogen bond donor.
(b) N(1) is a hydrogen bond acceptor and C(6)NH_2 is a hydrogen bond donor
(c) Both N(3) and C(6)NH_2 are hydrogen bond acceptors
(d) Both N(1) and C(6)NH_2 are hydrogen bond acceptors

52. ^1H NMR spectrum of an organic compound recorded on a 500 MHz spectrometer showed a quartet with line positions at 1759, 1753, 1747, 1741 Hz. Chemical shift (δ) and coupling constant (Hz) of the quartet are
(a) 3.5 ppm, 6 Hz (b) 3.5 ppm, 12 Hz (c) 3.6 ppm, 6 Hz (d) 3.6 ppm, 12 Hz

53. The weight of the configuration with two up and three down spins in a system with five spin $\frac{1}{2}$ particles is
(a) 120 (b) 60 (c) 20 (d) 10

54. For a reaction with an activation energy of 49.8 kJ mol^{-1}, the ratio of the rate constants at 600 K and 300 K, (k_{600}/k_{300}), is approximately (R = 8.3 J mol^{-1} K^{-1})
(a) ln (10) (b) 10 (c) 10 + e (d) e^{10}

55. Covariance is defined by the relation $Cov(x, y) = \langle xy \rangle - \langle x \rangle \langle y \rangle$. Given the arbitrary constants A, B and C, $Cov(x, y)$ will be zero only when
(a) $y = Ax^2$ (b) $y = Ax^2 + B$ (c) $y = Ax + B$ (d) $y = Ax^2 + Bx + C$

56. Each void in a two dimensional hexagonal close-packed layer of circles is surrounded by
(a) six circles (b) three circles (c) four circles (d) twelve circles

57. The ionic mobilities of NH_4^+ and HCO_3^- are $6\times10^{-4}V^{-1}s^{-1}$ and $5\times10^{-4}V^{-1}s^{-1}$, respectively. The transport numbers of NH_4^+ and HCO_3^- are, respectively
(a) 0.545 and 0.455 (b) 0.455 and 0.545 (c) 0.090 and 0.910 (d) 0.910 and 0.090

58. The ionic strength of a solution containing 0.008 M $AlCl_3$ and 0.005 M KCl is
(a) 0.134 M (b) 0.053 M (c) 0.106 M (d) 0.086 M

59. The correct normalized wavefunction for one of the sp^2 hybrid orbitals is
(a) $\frac{1}{3}\psi_{2s} + \frac{1}{3}\psi_{2px} + \frac{1}{3}\psi_{2py}$ (b) $\frac{1}{\sqrt{3}}\psi_{2s} + \frac{2}{\sqrt{3}}\psi_{2px} + \frac{1}{\sqrt{6}}\psi_{2py}$
(c) $\frac{1}{\sqrt{3}}\psi_{2s} + \frac{1}{\sqrt{2}}\psi_{2px} + \frac{1}{\sqrt{6}}\psi_{2py}$ (d) $\frac{1}{\sqrt{3}}\psi_{2s} + \frac{1}{2\sqrt{3}}\psi_{2px} + \frac{1}{\sqrt{6}}\psi_{2py}$

60. The correct statement in the context of NMR spectroscopy is
(a) static magnetic field is used to induce transition between the spin states
(b) magnetization vector is perpendicular to the applied static magnetic field
(c) the static magnetic field is used to create population difference between the spin states
(d) static magnetic field induces spin-spin coupling.

61. The parameter which always decreases during a spontaneous process at constant S and V, is
(a) U (b) H (c) C_P (d) q

62. Triple point pressure of substances A, B, C and D are 0.2, 0.5, 0.8 and 1.2 bar, respectively. The substance which sublimes under standard conditions on increasing temperature is
(a) A (b) B (c) C (d) D

63. According to the transition state theory, the plot with slope equal to $\frac{-\Delta H^{\#}}{R}$ is
(a) ln k vs. T (b) $\ln\left(\frac{k}{T}\right)$ vs. T (c) $\ln\left(\frac{k}{T}\right)$ vs. $\frac{1}{T}$ (d) ln k vs. $\frac{1}{T}$

64. The transition that belongs to the Lyman series in the hydrogen-atom spectrum is
(a) $1s \leftarrow 4s$ (b) $1s \leftarrow 4p$ (c) $2s \leftarrow 4s$ (d) $2s \leftarrow 4p$

65. The molecule that possesses S_4 symmetry element is
(a) ethylne (b) allene (c) benzene (d) 1, 3-butadiene

66. Vibrations of diatomic molecules are usually modelled by a harmonic potential. If the potential is given by x^2, the correct statement is
(a) force is $2x$ and force constant is 2 (b) force is $-2x$ and force constant is 2
(c) force is $2x$ and force constant is -1 (d) force is $-2x$ and force constant is -1

67. When 1×10^{-5} g of a fatty acid (M = 602.3 g/mol) was placed on water as a surface film, a monomolecular layer of area 100 cm^2 was formed on compression. The cross-sectional area (in $Å^2$) of the acid molecule is
(a) 50 (b) 100 (c) 150 (d) 200

68. Mark-Houwink equation $\left([\eta] = KM^{a}\right)$ is used for the determination of
(a) number-average molar mass
(b) weight-average molar mass
(c) viscosity-average molar mass
(d) z-average molar mass

69. Many properties of nanoparticles are significantly different than the corresponding bulk materials due to
(a) smaller band gap of nanoparticles compared to bulk
(b) higher heterogeneity of the nanoparticle solutions
(c) larger ratio of surface area to volume of the nanoparticles compared to the bulk
(d) smaller ratio of surface area to volume of the nanoparticles compared to the bulk

70. The correct match for the following is

Column-A	Column-B
(i) camphor	(A) structural protein
(ii) insulin	(B) hormone
(iii) keratin	(C) enzyme
	(D) steroid
	(E) terpene

(a) (i)-(A); (ii)-(C); (iii)-(E) (b) (i)-(E); (ii)-(B); (iii)-(A)
(c) (i)-(D); (ii)-(C); (iii)-(A) (d) (i)-(E); (ii)-(B); (iii)-(D)

PART-C

71. Consider the following statements for KC_8:
(A) It is paramagnetic, (B) It has eclipsed layer structure, (C) Its electrical conductivity is greater than that of graphite. The correct answer is
(a) A and B (b) A and C (c) B and C (d) A, B and C

72. Among the following, choose the correct products that are formed in the reaction of S_2Cl_2 with ammonia in CCl_4:
NH_4Cl(A), S_4N_4(B), S_8(C), and $S_3N_3Cl_3$(D).
(a) A, B and C (b) A, B and D (c) B, C and D (d) A, C and D

73. For $[Ce(NO_3)_4(OPPh_3)_2]$, from the following
A. Its aqueous solution is yellow-orange in colour
B. Coordination number of Ce is ten
C. It shows metal to ligand charge transfer
D. It is diamagnetic in nature

The correct answer is
(a) A and B (b) A and C (c) A, B and D (d) B, C and D

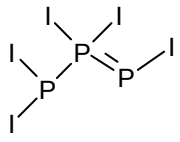
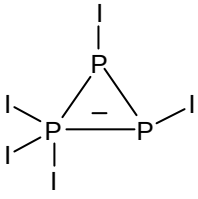
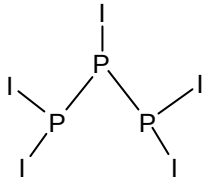
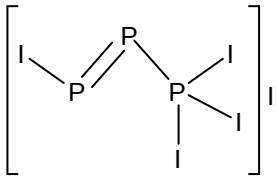
74. Consider the following statements, I and II:
I: $[Rh(CO)_2I_2]^-$ catalytically converts CH_3I and CO to CH_3COI
II: $[Rh(CO)_2I_2]^-$ is diamagnetic in nature
The correct from the following is
(a) I and II are correct and II is an explanation of I
(b) I and II are correct and II is not an explanation of I
(c) I is correct and II is incorrect
(d) I and II are incorrect

75. In a direct isotopic dilution method for determination of phosphate, 2 mg of $^{32}PO_4^{3-}$ (specific activity 3100 disintegration s^{-1} mg^{-1}) was added to 1g of a sample solution. The 30 mg of phosphate isolated from it has an overall activity of 3000 disintegration s^{-1}. The % mass of PO_4^{3-} in the sample is
(a) 30 (b) 6 (c) 9 (d) 15

76. Consider the following statements for $[FeO_4]^{4-}$.
A. It is paramagnetic
B. It has T_d symmetry
C. Adopts distorted square planar geometry
D. Shows approximately D_{2d} symmetry
The correct answer is
(a) A, B and C (b) A, C and D (c) A and D (d) A and B

77. The geometry of $[ReH_9]^{2-}$ is
(a) monocapped square antiprism (b) monocapped cube
(c) tricapped trigonal prism (d) heptagonal bipyramid

78. The reaction between PI_3, $PSCl_3$ and zinc powder gives P_3I_5 as one of the products. The solution state ^{31}P NMR spectrum of P_3I_5 shows a doublet (δ 98) and a triplet (δ 102). The correct structure of P_3I_5 is

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

79. Some molecules and their properties in liquid ammonia are given in columns A and B respectively. Match column A with column B

Column A	Column B
(A) Cl_2	(i) Weak acid
(B) S_8	(ii) Strong acid
(C) CH_3CO_2H	(iii) Disproportionation
(D) Urea	(iv) Solvolysis and disproportionation

The correct match is
(a) (A) – (i); (B) – (ii); (C) – (iii); (D) – (iv)
(b) (A) – (ii); (B) – (iii); (C) – (iv); (D) – (i)
(c) (A) – (iii); (B) – (iv); (C) – (i); (D) – (ii)
(d) (A) – (iv); (B) – (iii); (C) – (ii); (D) – (i)

80. The spectroscopic ground state term symbols for the octahedral aqua complexes of Mn(II), Cr(III) and Cu(II), respectively, are
(a) ^{2}H, ^{4}F and ^{2}D (b) ^{6}S, ^{4}F and ^{2}D
(c) ^{2}H, ^{2}H and ^{2}D (d) ^{6}S, ^{4}F and ^{2}P

81. From the following transformations,
A. Epoxidation of alkene
B. Diol dehydrase reaction
C. Conversion of ribonucleotide-to-deoxyribonucleotide
D. 1, 2-carbon shift in organic substrates
those promoted by coenzyme B_{12} are
(a) A and B (b) B, C and D (c) A, B and D (d) A, B and C

82. Match the items in column A with the appropriate items in column B

	Column A		**Column B**
(A)	Metallothioneins	(i)	*cis*-$[Pd(NH_3)_2Cl_2]$
(B)	Plastocyanin	(ii)	Cysteine rich protein
(C)	Ferritin	(iii)	Electron transfer
(D)	Chemotherapy	(iv)	Iron transport
		(v)	Iron storage
		(vi)	Carboplatin

The correct answer is
(a) (A) – (ii); (B) – (iii); (C) – (v); (D) – (iv)
(b) (A) – (ii); (B) – (iii); (C) – (iv); (D) – (i)
(c) (A) – (ii); (B) – (iii); (C) – (v); (D) – (vi)
(d) (A) – (iii); (B) – (v); (C) – (vi); (D) – (ii)

83. For OH^- catalysed S_N1 conjugate base mechanism of $\left[Co\left(NH_3\right)_5Cl\right]^{2+}$, the species obtained in the first step of the reaction is/are

(a) $\left[Co\left(NH_3\right)_5\left(OH\right)\right]^{2+} + Cl^-$ (b) $\left[Co\left(NH_3\right)_4\left(NH_2\right)Cl\right]^{+} + H_2O$

(c) $\left[Co\left(NH_3\right)_4\left(NH_2\right)\right]^{2+} + Cl^-$ (d) $\left[Co\left(NH_3\right)_5Cl\left(OH\right)\right]^{+}$ only

84. Match the species in column X with their properties in column Y

Column-X
(1) Heme A
(2) Water splitting enzyme
(3) $\left[Mn\left(H_2O\right)_6\right]^{2+}$

Column-Y
(i) oxo-bridged, Mn_4 cluster
(ii) tetragonal elongation
(iii) Predominantly $\pi \rightarrow \pi^*$, electronic transitions

(4) $\left[Cr\left(H_2O\right)_6\right]^{2+}$

(iv) $d \rightarrow d$ spin-forbidden transitions

(v) tetragonal compression

The correct answer is

(a) (1)-(iii), (2)-(i), (3)-(v), (4)-(ii) (b) (1)-(iii), (2)-(i), (3)-(iv), (4)-(ii)

(c) (1)-(v), (2)-(iii), (3)-(iv), (4)-(ii) (d) (1)-(iii), (2)-(i), (3)-(iv), (4)-(v)

85. According to isolobal analogy, the right set of fragments that might replace $Co(CO)_3$ in $\left[Co_4\left(CO\right)_{12}\right]$ is

(a) CH, BH and $Mn(CO)_5$ (b) P, CH and $Ni\left(\eta^5\text{-}C_5H_5\right)$

(c) $Fe(CO)_4$, CH_2 and $SiCH_3$ (d) BH, $SiCH_3$ and P

86. According to Wade's rules, the correct structural types of $\left[Co\left(\eta^5\text{-}C_5H_5\right)B_4H_8\right]$ and $\left[Mn\left(\eta^2-B_3H_8\right)\left(CO\right)_4\right]$ are

(a) closo and nido (b) nido and arachno (c) closo and arachno (d) nido and nido

87. The correct geometry of $\left[Rh_6C\left(CO\right)_{15}\right]^{2-}$ is

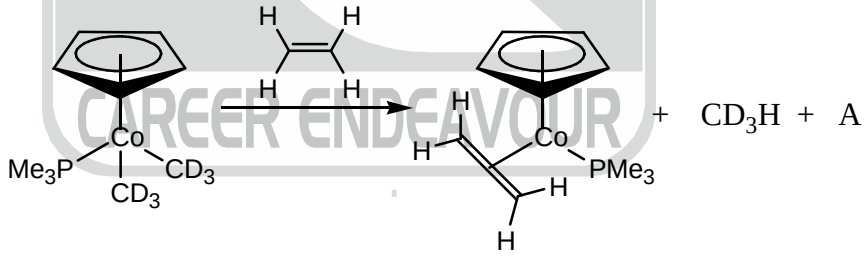
(a) octahedron (b) pentagonal pyramid (c) trigonal prism (d) monocapped square pyramid

88. The final product(s) of the reaction of arachno borane, B_4H_{10} with NMe_3 is/are

(a) $\left[BH_3.NMe_3\right]$ and $\left[B_3H_7.NMe_3\right]$ (b) $\left[BH_2\left(NMe_3\right)_2\right]^+\left[B_3H_8\right]^-$

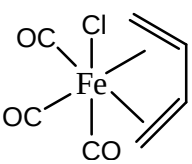
(c) $\left[B_4H_{10}.NMe_3\right]$ (d) $\left[B_4H_{10}.NMe_3\right]$ and $\left[BH_2\left(NMe_3\right)_2\right]^+\left[B_3H_8\right]^-$

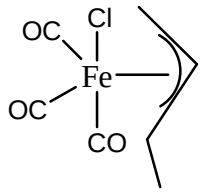
89. Product A in the following reaction is

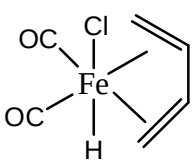


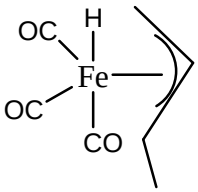
(a) $D_2C{=}CD_2$ (b) $D_3C{-}CD_3$ (c)  (d) $H_2C{=}CD_2$

90. Treatment of $Fe(CO)_5$ with 1, 3-butadiene gives B that shows two signals in its ^1H NMR spectrum. B on treatment with HCl yields C which shows four signals in its ^1H NMR spectrum. The compound C is

(a) 

(b) 

(c) 

(d) 

91. In the following redox reaction with an equilibrium constant $K = 2.0 \times 10^8$,

$$\left[Ru\left(NH_3\right)_6\right]^{2+} + \left[Fe\left(H_2O\right)_6\right]^{3+} \rightleftharpoons \left[Ru\left(NH_3\right)_6\right]^{3+} + \left[Fe\left(H_2O\right)_6\right]^{2+}$$

the self exchange rates for oxidant and reductant are 5.0 $M^{-1}s^{-1}$ and 4.0×10^3 $M^{-1}s^{-1}$, respectively. The approximate rate constant ($M^{-1}s^{-1}$) for the reaction is

(a) 3.16×10^6 (b) 2.0×10^6 (c) 6.32×10^6 (d) 3.16×10^4

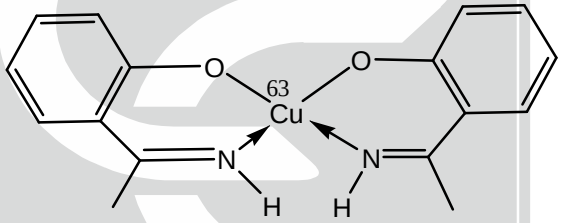
92. The correct statement for a Fischer carbene complex is

(a) the carbene carbon is electrophilic in nature
(b) metal exists in high oxidation state
(c) metal fragment and carbene are in the triplet states
(d) CO ligands destabilize the complex

93. The acidic solution containing trimethylamine (A), dimethylamine (B) and methyl amine (C) (pK_a of cations 9.8, 10.8 and 10.6, respectively) was loaded on a cation exchange column. The order of their elution with a gradient of increasing pH > 7 is

(a) A < C < B (b) B < C < A (c) B < A < C (d) C < B < A

94. For complex A, deuteration of NH protons does not alter the EPR spectrum. The number of hyperfine lines expected in the EPR $\left[I\left(^{63}Cu\right)=\frac{3}{2}\right]$ spectrum of A is

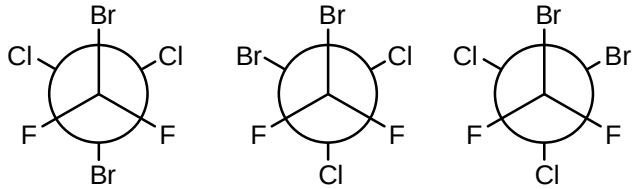


(a) 20 (b) 12 (c) 60 (d) 36

95. The numbers of triangular faces in square antiprism, icosahedron and tricapped trigonal prism (capped on square faces), respectively, are

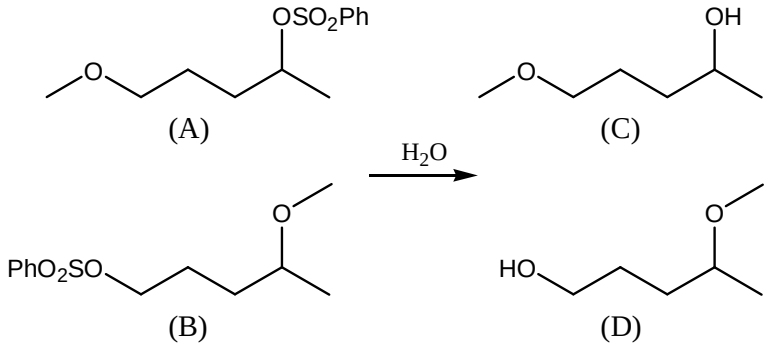
(a) 8, 20 and 14 (b) 8, 20 and 12 (c) 10, 12 and 14 (d) 10, 12 and 12

96. Number of lines in the ^{19}F NMR spectrum of $F_2C(Br)–C(Br)Cl_2$ at –120ºC assuming it a mixture of static conformations given below, are



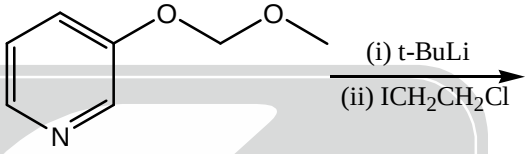
(a) one (b) two (c) four (d) five

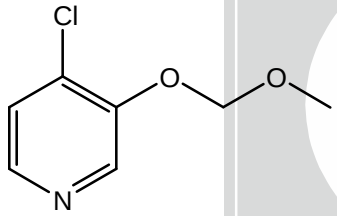
97. The correct statement for the reactants A, B to give products C, D is

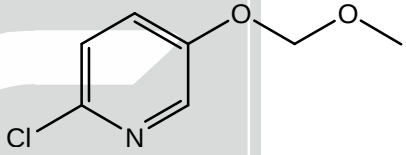


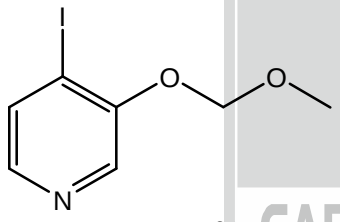
(a) A gives C and B gives D (b) A gives D and B gives C
(c) A and B give identical amounts of C and D (d) A and B give D

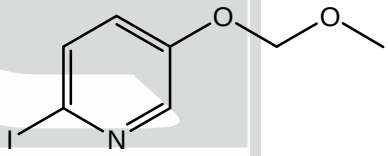
98. The major product formed in the following reaction is



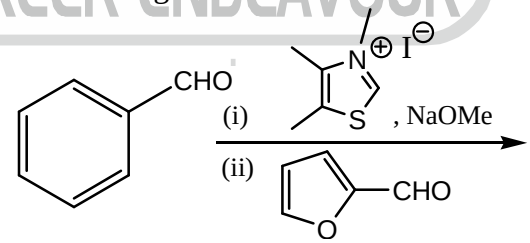
(a) 

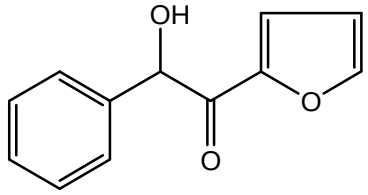
(b) 

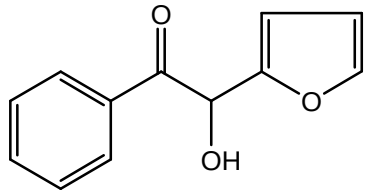
(c) 

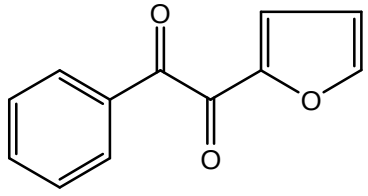
(d) 

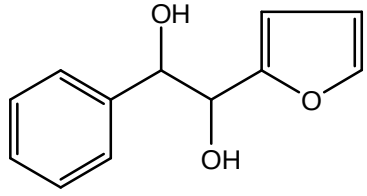
99. The major product formed in the following reaction is



(a) 

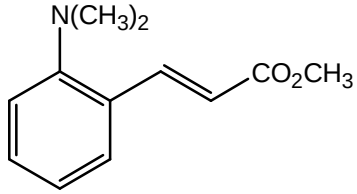
(b) 

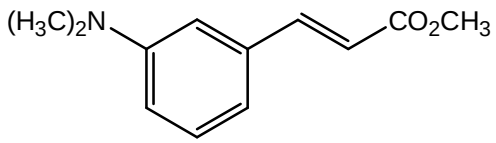
(c) 

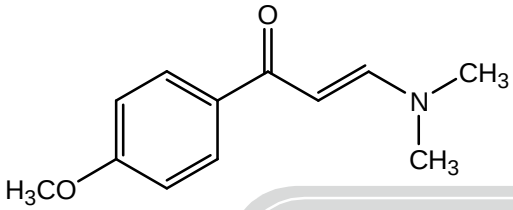
(d) 

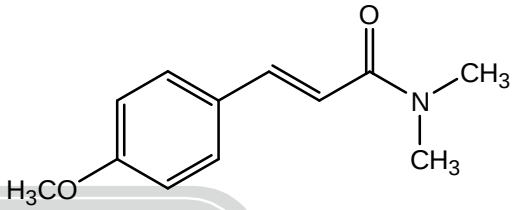
100. The compound that exhibits following spectral data is

^{1}H NMR : δ 8.0(d, J = 12.3 Hz, 1H), 7.7(d, J = 8.0 Hz, 2H), 6.8(d, J = 8.0 Hz, 2H), 5.8(d, J = 12.3 Hz, 1H), 3.8(s, 3H), 3.0(s, 6H) ppm ,

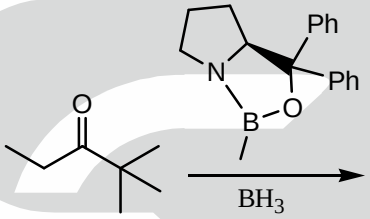
(a) 

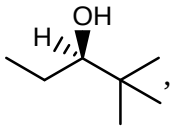
(b) 

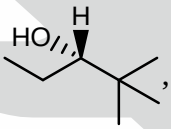
(c) 

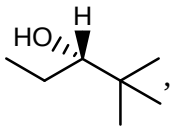
(d) 

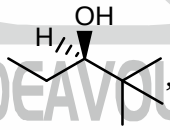
101. The major product in the following reaction is



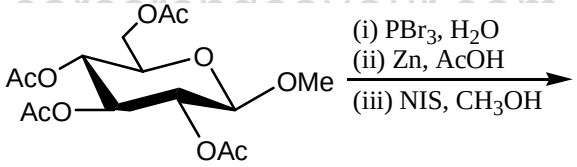
(a)  , by Re face attack

(b)  , by Re face attack

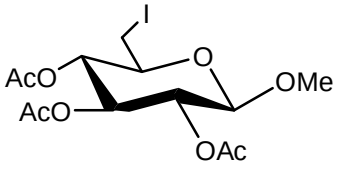
(c)  , by Si face attack

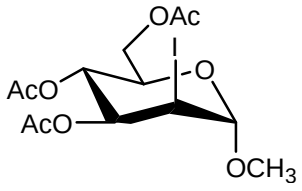
(d)  , by Si face attack

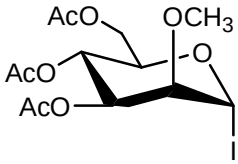
102. The major product formed in the following reaction is

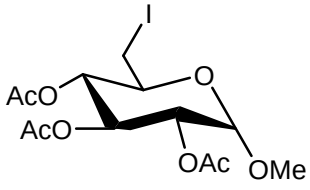


NIS : N-iodosuccinimide

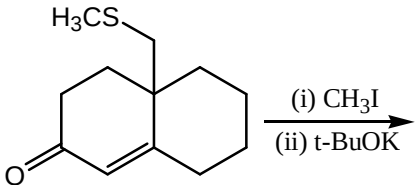
(a) 

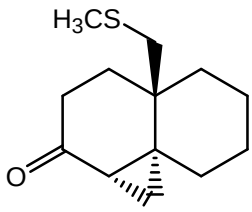
(b) 

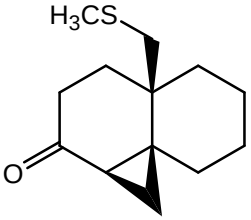
(c) 

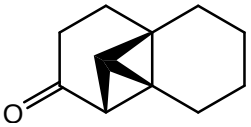
(d) 

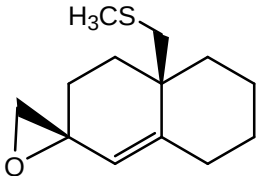
103. The major product formed in the following reaction is



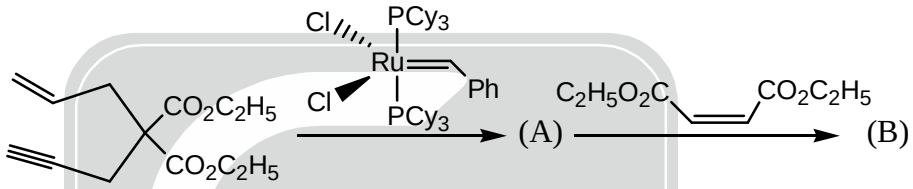
(a) 

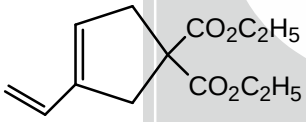
(b) 

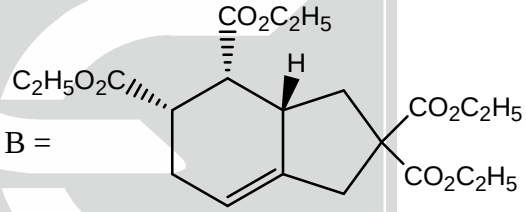
(c) 

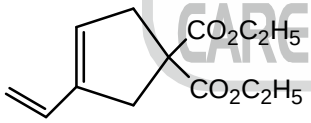
(d) 

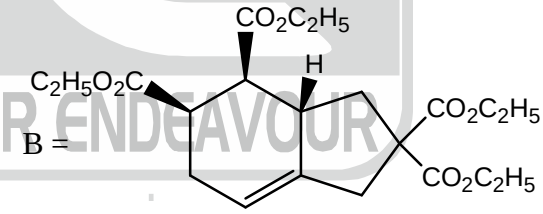
104. The major product formed in the following reaction is

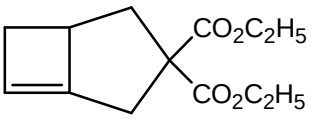


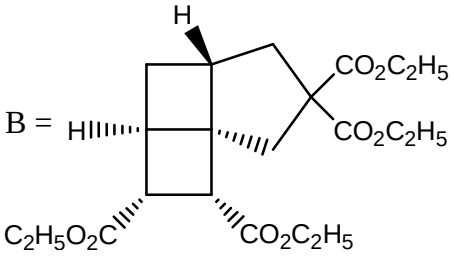
(a) A = 

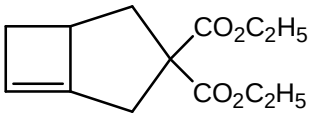
B = 

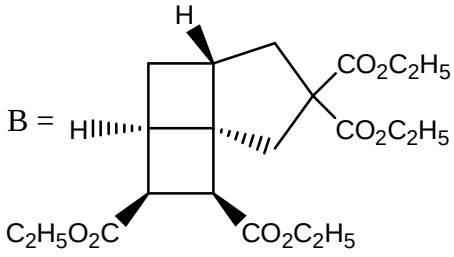
(b) A = 

B = 

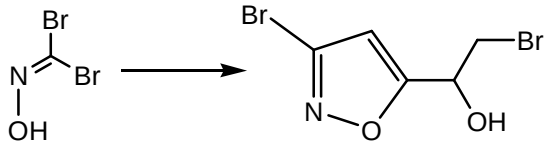
(c) A = 

B = 

(d) A = 

B = 

105. Correct sequence of reagents for the following conversion is



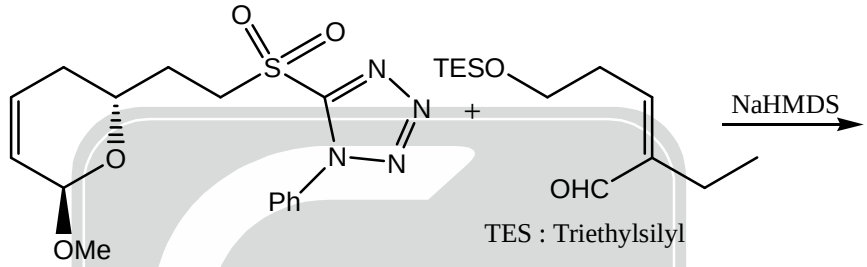
(a) (i) K_2CO_3, (ii) $HC \equiv CCOCH_3$, (iii) Br_2, (iv) $NaBH_4$

(b) (i) $NaBH_4$, (ii) $HC \equiv CCOCH_3$, (iii) Br_2, (iv) K_2CO_3

(c) (i) $HC \equiv CCOCH_3$, (ii) K_2CO_3, (iii) Br_2, (iv) $NaBH_4$

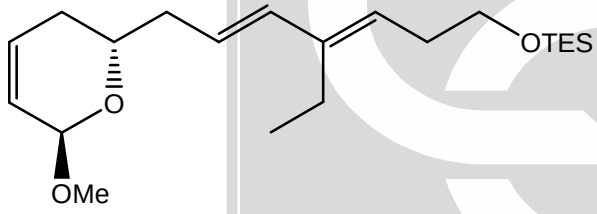
(d) (i) Br_2, (ii) $HC \equiv CCOCH_3$, (iii) K_2CO_3, (iv) $NaBH_4$

106. The major product in the following reaction is

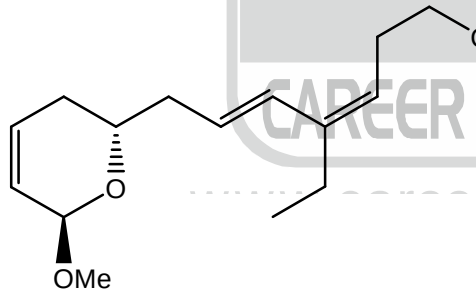


TES : Triethylsilyl

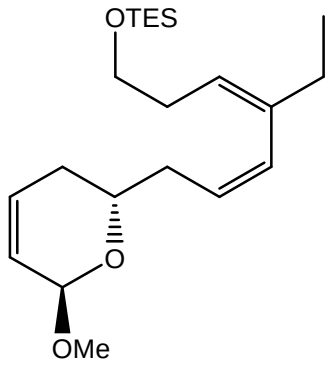
(a)



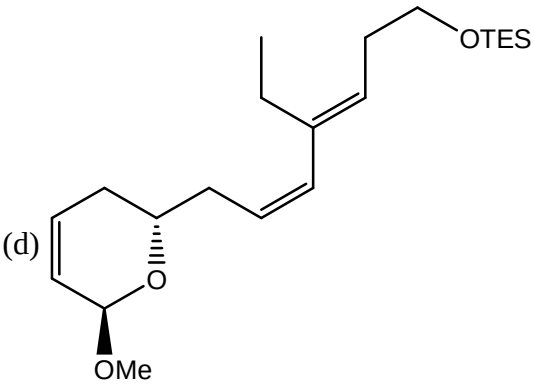
(b)



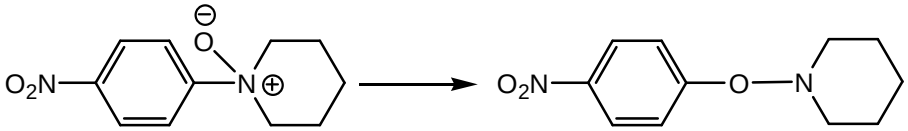
(c)

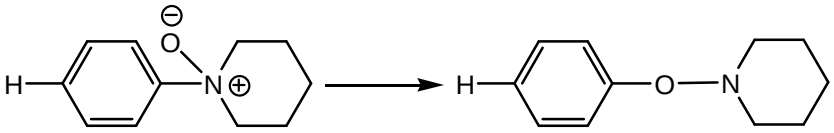


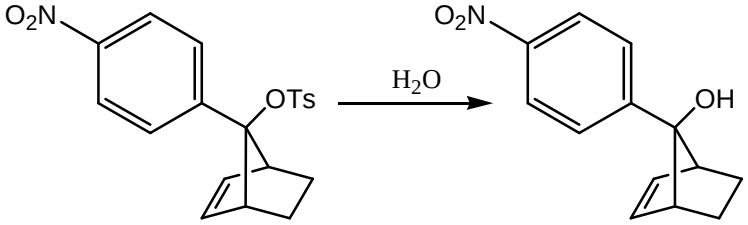
(d)

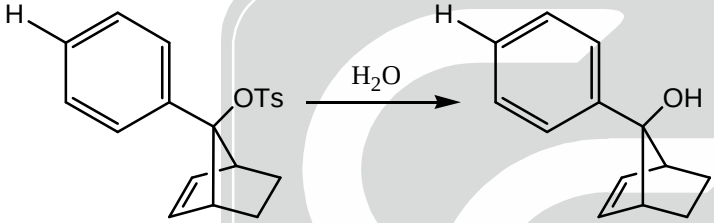


107. For the four reactions given below, the rates of the reactions will vary as

(1) 

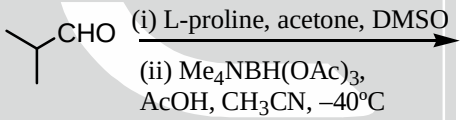
(2) 

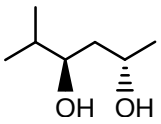
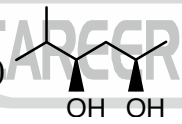
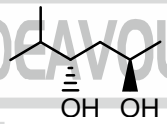
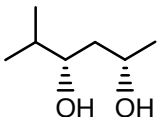
(3) 

(4) 

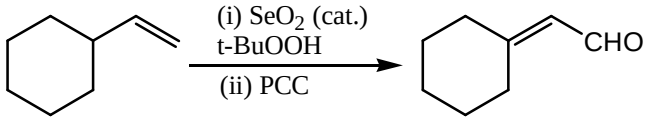
(a) 1 > 2 and 3 > 4 (b) 2 > 1 and 3 > 4 (c) 2 > 1 and 4 > 3 (d) 1 > 2 and 4 > 3

108. The major product formed in the following reaction is



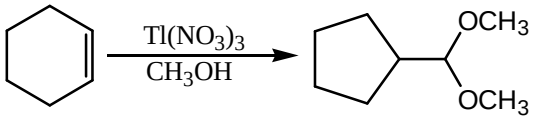
(a)  (b)  (c)  (d) 

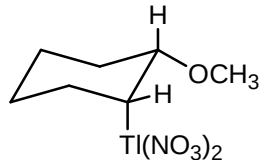
109. The correct sequence of pericyclic reactions involved in the following transformation is

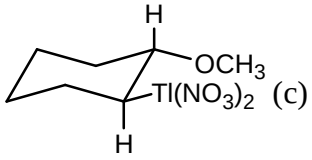


(a) (i) ene reaction, (ii) [2, 3]-sigmatropic shift, (iii) [3, 3]-sigmatropic shift
(b) (i) ene reaction, (ii) [3, 3]-sigmatropic shift, (iii) [1, 3]-sigmatropic shift
(c) (i) [2, 3]-sigmatropic shift, (ii) ene reaction, (iii) [1, 3]-sigmatropic shift,
(d) (i) [1, 3]-sigmatropic shift, (ii) [2, 3]-sigmatropic shift, (iii) [3, 3]-sigmatropic shift

110. The intermediate that leads to the product in the following transformation is

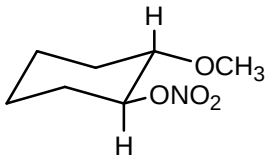


(a) 

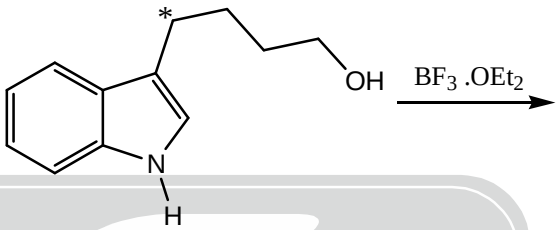
(b) 

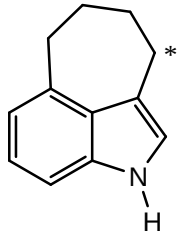
(c)

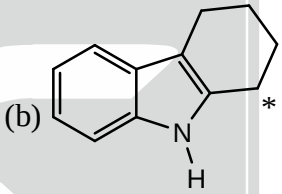
(c) 

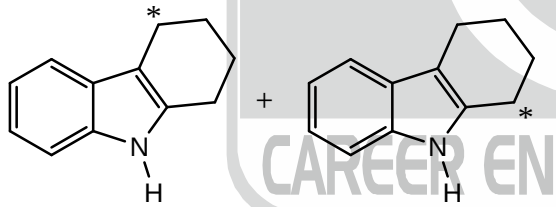
(d) 

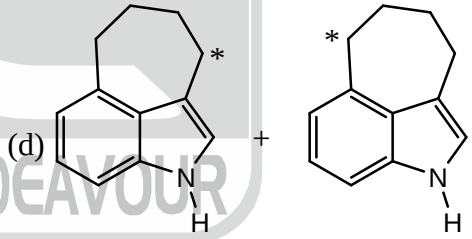
111. Product(s) of the following reaction is (are) [*-indicates isotopically labelled carbon]



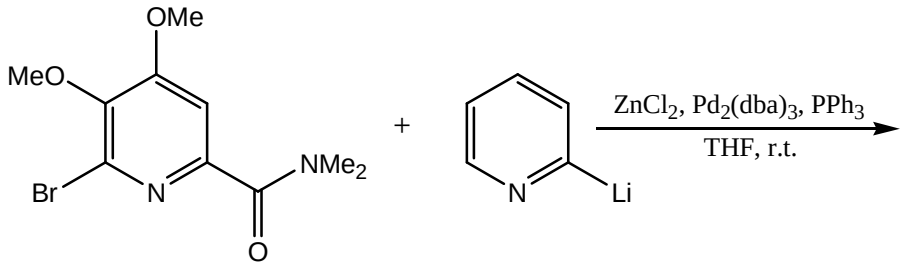
(a) 

(b) 

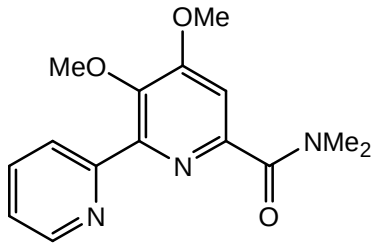
(c) 

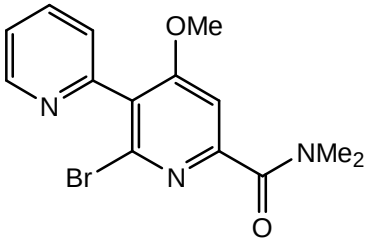
(d) 

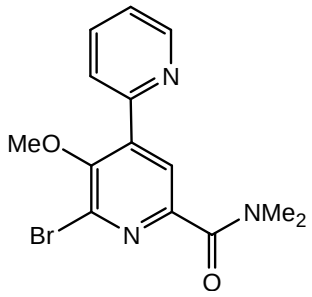
112. The major product formed in the following reaction is

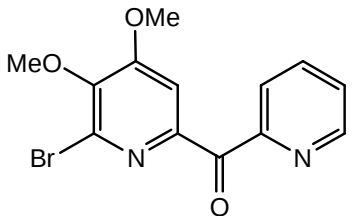


(dba = dibenzylidene acetone)

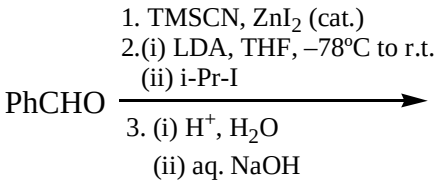
(a) 

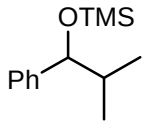
(b) 

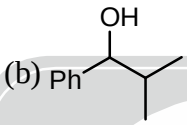
(c) 

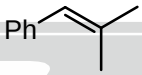
(d) 

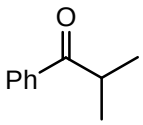
113. The major product formed in the following reaction is



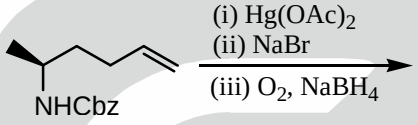
(a) 

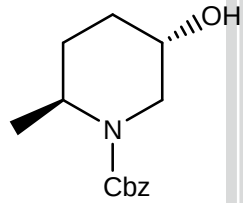
(b) 

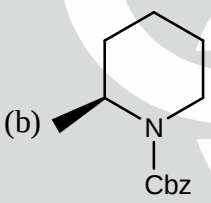
(c) 

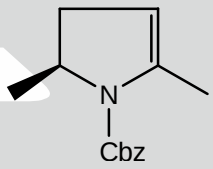
(d) 

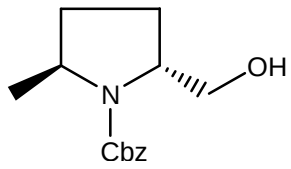
114. The major product formed in the following reaction is



(a) 

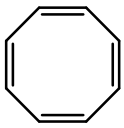
(b) 

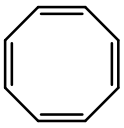
(c) 

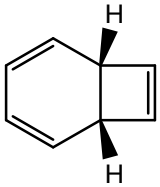
(d) 

115. Correct match for the products of the reactions in Column-A with the properties in Column-B is

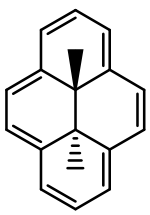
Column-A **Column-B**

(i)  + 2K ⟶ (P) aromatic

(ii)  + H_2SO_4 ⟶ (Q) antiaromatic

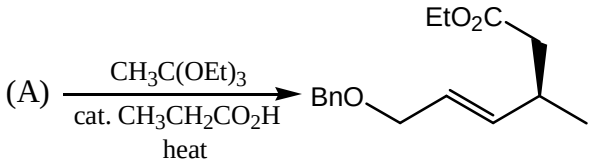
(iii) 

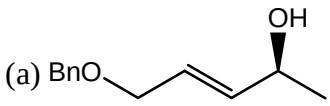
$\xrightarrow{\text{heat}}$ (R) non-aromatic

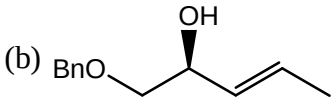
(iv)  + 2K $\xrightarrow{\text{heat}}$ (S) homoaromatic

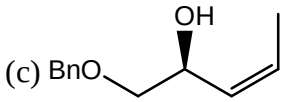
(a) (i)-P, (ii)-S, (iii)-R, (iv)-Q
(b) (i)-P, (ii)-R, (iii)-Q, (iv)-S
(c) (i)-Q, (ii)-R, (iii)-S, (iv)-P
(d) (i)-S, (ii)-Q, (iii)-R, (iv)-P

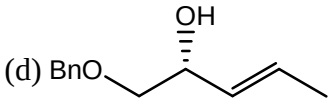
116. The correct starting compound A in the following reaction is



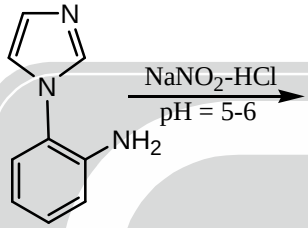
(a) 

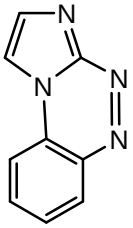
(b) 

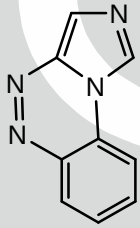
(c) 

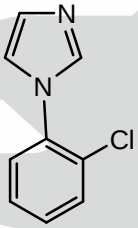
(d) 

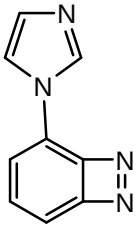
117. The major product formed in the following reaction is



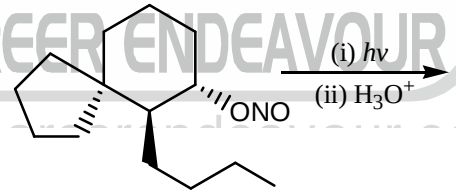
(a) 

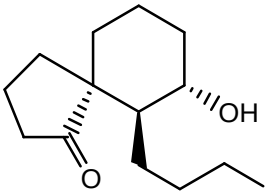
(b) 

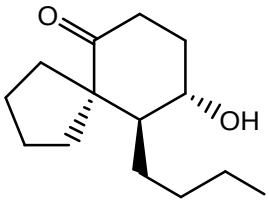
(c) 

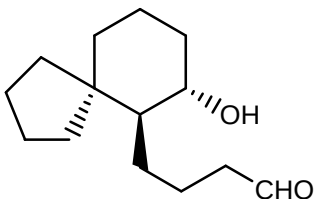
(d) 

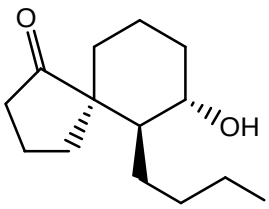
118. The major product formed in the following reaction is



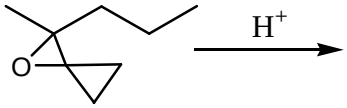
(a) 

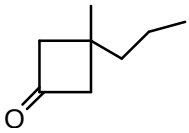
(b) 

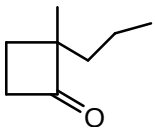
(c) 

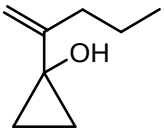
(d) 

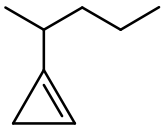
119. The major product formed in the following reaction is



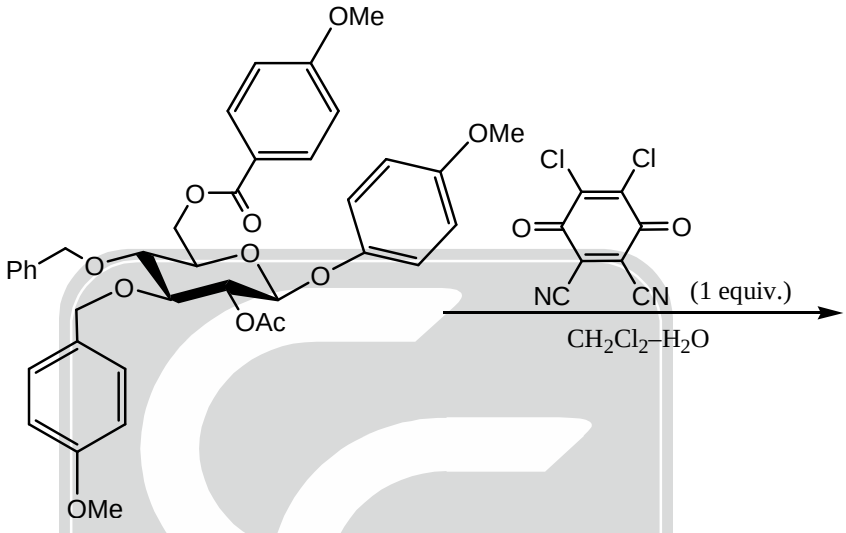
(a) 

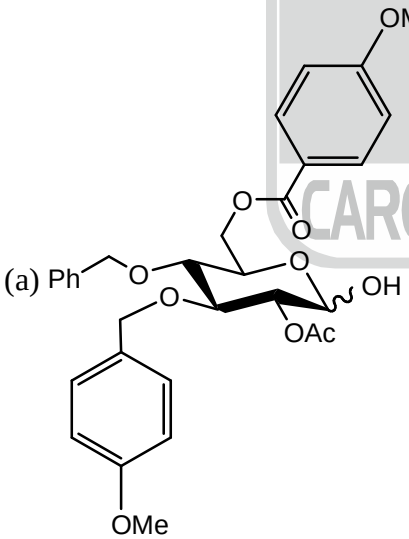
(b) 

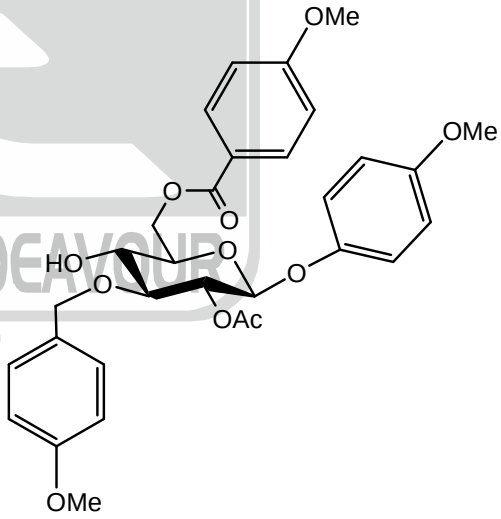
(c) 

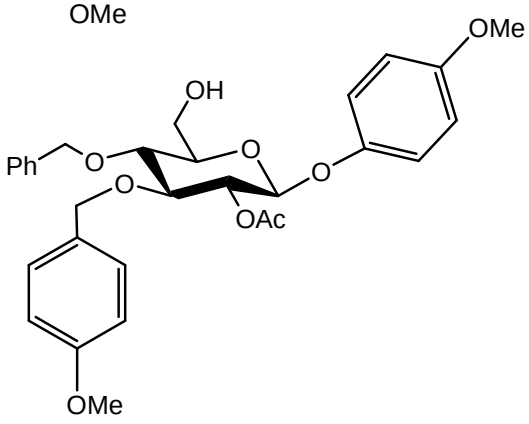
(d) 

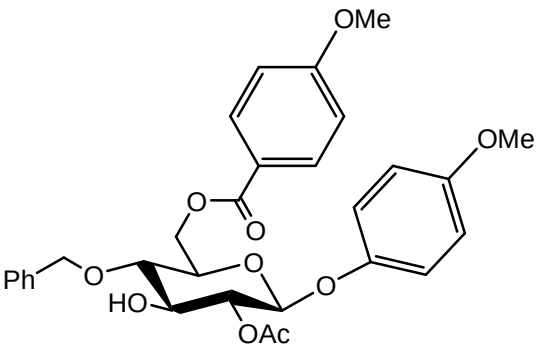
120. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

121. A constant of motion of hydrogen atom in the presence of spin-orbit coupling is
(a) ℓ (b) s (c) $\ell + s$ (d) $\ell - s$

122. The orbital degeneracy of the level of a one-electron atomic system with Z = 5 and energy $\approx$ –13.6 eV, is
(a) 1 (b) 5 (c) 25 (d) 36

123. If we write a normalized wavefunction $\psi = \hat{A}\phi$, then ϕ is also normalized when
(a) $\hat{A}$ is hermitian (b) $\hat{A}$ is anti-hermitian
(c) $\hat{A}$ is unitary (d) $\hat{A}$ is any linear operator

124. The ground state of a certain system with energy $\in_0$ is subjected to a perturbation V, yielding a first-order correction $\in_1$. If E_0 is the true ground-state energy of the perturbed system, the inequality that always holds is
(a) $\in_1 \geq 0$ (b) $\in_1 \geq E_0$ (c) $\in_0 + \in_1 \leq E_0$ (d) $\in_0 + \in_1 \geq E_0$

125. The spatial part of an excited state $b\,^3\Sigma_u^+$ of hydrogen molecule is proportional to $\left[1\sigma_g(1)1\sigma_u(2) - 1\sigma_g(2)1\sigma_u(1)\right]$. Using LCAO–MO expansion of $1\sigma_g$ and $1\sigma_u$ in terms of 1s-atomic orbitals, one can infer that this wavefunction has
(a) only ionic parts (b) only covalent parts
(c) both ionic and covalent parts (d) neither ionic nor covalent parts

126. The highest molecular orbitals for an excited electronic configuration of the oxygen molecule are $\left[1\pi_g\right]^1\left[3\sigma_u\right]^1$. A possible molecular term symbol for oxygen with this electronic configuration is
(a) $^1\pi$ (b) $^3\Sigma$ (c) $^1\Delta$ (d) $^1\Sigma$

127. For H_2O molecule, the electronic transition from the ground state to an excited state of B_1 symmetry is

C_{2v}	E	C_2	σ_v	σ'_v	
A_1	1	1	1	1	z, z^2, x^2, y^2
A_2	1	1	–1	–1	xy
B_1	1	–1	1	–1	x, xz
B_2	1	–1	–1	1	y, yz

(a) not allowed (b) allowed with x polarisation
(c) allowed with y polarisation (d) allowed with z polarisation

128. The pair of symmetry points groups that are associated with only polar molecules is
(a) $C_{2v}, D_{\infty h}$ (b) C_{3v}, C_{2h} (c) D_{2h}, T_d (d) $C_{2v}, C_{\infty v}$

129. The rotational constant and the fundamental vibrational frequency of HBr are, respectively, 10 cm^{-1} and 2000 cm^{-1}. The corresponding values for DBr approximately are
(a) 20 cm^{-1} and 2000 cm^{-1} (b) 10 cm^{-1} and 1410 cm^{-1}
(c) 5 cm^{-1} and 2000 cm^{-1} (d) 5 cm^{-1} and 1410 cm^{-1}

130. Among the following, both microwave and rotational Raman active molecule is
(a) CH_4 (b) N_2O (c) C_2H_4 (d) CO_2

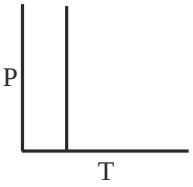
131. In a 200 MHz NMR spectrometer, a molecule shows two doublets separated by 2 ppm. The observed coupling constant is 10 Hz. The separation between these two signals and the coupling constant in a 600 MHz spectrometer will be, respectively
(a) 600 Hz and 30 Hz (b) 1200 Hz and 30 Hz
(c) 600 Hz and 10 Hz (d) 1200 Hz and 10 Hz

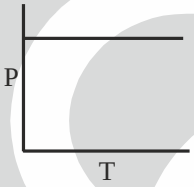
132. The equation of state for one mole of a gas is given by $P(V-b)=RT$, where b and R are constants.

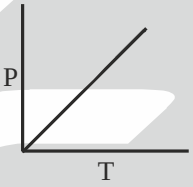
The value of $\left(\frac{\partial H}{\partial P}\right)_T$ is

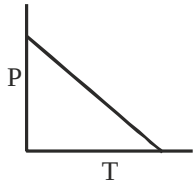
(a) $V-b$ (b) b (c) 0 (d) $\frac{RT}{P}+b$

133. The volume change in a phase transition is zero. From this, we may infer that the phase boundary is represented by

(a) 

(b) 

(c) 

(d) 

134. The partial derivative $\left(\frac{\partial T}{\partial V}\right)_P$ is equal to

(a) $-\left(\frac{\partial P}{\partial S}\right)_T$ (b) $-\left(\frac{\partial P}{\partial S}\right)_V$ (c) $-\left(\frac{\partial P}{\partial S}\right)_n$ (d) $-\left(\frac{\partial P}{\partial S}\right)_H$

135. If the energies of a bare proton aligned along and against an external static magnetic field (B_z) are $-\frac{\hbar\gamma B_z}{2}$ and $+\frac{\hbar\gamma B_z}{2}$, respectively, then the ratio of probabilities of finding the proton along and against the magnetic field is
(a) $e^{-\hbar\gamma B_z/4k_BT}$ (b) $e^{-\hbar\gamma B_z/2k_BT}$ (c) $e^{\hbar\gamma B_z/2k_BT}$ (d) $e^{\hbar\gamma B_z/k_BT}$

136. Partition function of a one-dimensional oscillator having equispaced energy levels with energy spacing equal to k_BT and zero ground state energy is

(a) e (b) $\frac{1}{(e-1)}$ (c) $\frac{e}{(e-1)}$ (d) $\frac{1}{(e+1)}$

137. A reaction goes through the following elementary steps

$$A+B \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} 2C \qquad (\text{fast})$$

$$A+C \xrightarrow{k_2} D \qquad (\text{slow})$$

Assuming that steady approximation can be applied to C, on doubling the concentration of A, the rate of production of D will increase by (assuming $k_2[A] << k_{-1}[C]$)

(a) 2 times (b) 4 times (c) 8 times (d) $2\sqrt{2}$ times

138. The rate of an acid-catalyzed reaction in aqueous solution follows rate equation

$$r = k\left[X^{+}\right]\left[Y^{2-}\right]\left[H^{+}\right]$$

If k_{16} and k_4 are rate constants for the reaction at ionic strength of 16 molL^{-1} and 4 molL^{-1}, respectively, $\ln\frac{k_4}{k_{16}}$, in terms of Debye-Hückel constant (B = 0.51), is

(a) 4B (b) 8B (c) 10B (d) 12B

139. For two reactions,

$$X(g)+Y(g)\longrightarrow Z(g) \quad (1)$$

$$M(g)+N(g)\longrightarrow P(g) \quad (2)$$

According to the collision theory, the ratio of squares of pre-exponential factors of reactions 2 (A_2) and 1(A_1) at the same temperature, $\left(\frac{A_2}{A_1}\right)^2$, is

Species	Mass(g/mol)	Diameter(nm)
X	5	0.3
Y	20	0.5
M	10	0.4
N	10	0.4

(a) 4/5 (b) 5/5 (c) 5/3 (d) 3/5

140. If the specific conductances of a sparingly soluble (1 : 1) salt (MW = 200 g mol^{-1}) in its saturated aqueous solution at 25ºC and that of water are 1.5×10^{-3} ohm^{-1} dm^{-1} and 1.5×10^{-5} ohm^{-1} dm^{-1}, respectively, and the ionic conductances for its cation and anion at infinite dilution are 0.485 and 1.0 ohm^{-1} dm^2 mol^{-1}, respectively, the solubility (in g L^{-1}) of the salt in water at 25º C is

(a) 1×10^{-6} (b) 1×10^{-3} (c) 2×10^{-1} (d) 2×10^{-4}

141. Given, (i) $Zn+4NH_3\longrightarrow Zn\left(NH_3\right)_4^{2+}+2e$, $E^0=1.03$ V

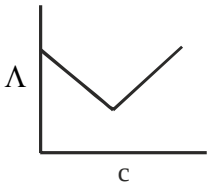
(ii) $Zn\longrightarrow Zn^{2+}+2e$, $E^0=0.763$V

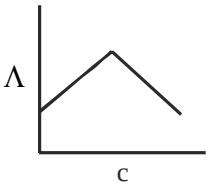
The formation constant of the complex $Zn\left(NH_3\right)_4^{2+}$ is approximately

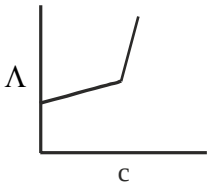
$$\left(\frac{2.303RT}{F}=0.0591\right)$$

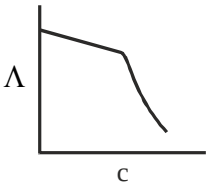
(a) 1×10^5 (b) 1×10^7 (c) 1×10^9 (d) 1×10^{12}

142. The molar conductivity (Λ) vs. concentration (c) plot of sodium dodecylsulfate in water is expected to look like

(a) 

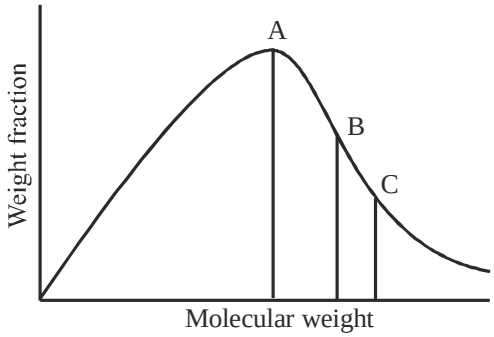
(b) 

(c) 

(d) 

143. The $\sin^2\theta$ values obtained from X-ray powder diffraction pattern of a solid are 2x, 4x, 6x, 8x where x is equal to 0.06. The wavelength of X-ray used to obtain this pattern is 1.54Å. The unit cell and the unit cell length, respectively are
(a) BCC, 3.146Å (b) FCC, 3.146Å (c) SCC, 6.281 Å (d) BCC, 1.544Å

144. Distribution of molar masses in a typical polymer sample is shown below

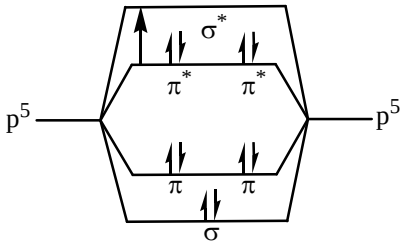


The A, B and C represent
(a) $\bar{M}_w, \bar{M}_v$ and $\bar{M}_n$, respectively (b) $\bar{M}_n, \bar{M}_v$ and $\bar{M}_w$, respectively
(c) $\bar{M}_v, \bar{M}_w$ and $\bar{M}_n$, respectively (d) $\bar{M}_n, \bar{M}_w$ and $\bar{M}_v$, respectively

145. Two bound stationary states, 1 and 2, of a one-electron atom, with $E_2 > E_1$ (E is the total energy) obey the following statement about their kinetic energy (T) and potential energy (V)
(a) $T_2 > T_1; V_2 > V_1$ (b) $T_2 > T_1 ; V_2 < V_1$
(c) $T_2 < T_1 ; V_2 > V_1$ (d) $T_2 = T_1 ; V_2 > V_1$

PART–B

21. In halogen molecules, the $\pi^* \rightarrow \sigma^*$ transitions are responsible for their colours as evident from the following figure



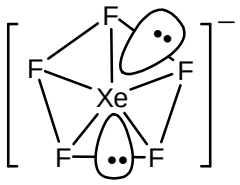
Correct option is (a)

22. The π-donor ligands such as Cl^-, Br^-, I^-, N-bonded NCS^- etc stabilize the TBP intermediate and favour the stereochemical change. The trans-forms tendency to isomers in the order

$$A = NO_2^- < Cl^- < NCS^- < OH^-$$

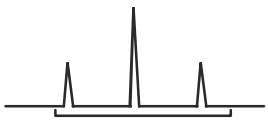
Correct option is (a)

23. $[XeF_5]^- \Rightarrow \frac{8+5+1}{2} = 7$ sp^3d^3 hybridization

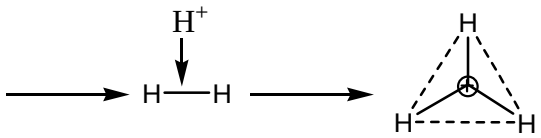


Pentagonal Planar

as 74% Xe are NMR inactive hence a singlet of five fluorine and due to 26% nuclei a doublet of satellite.



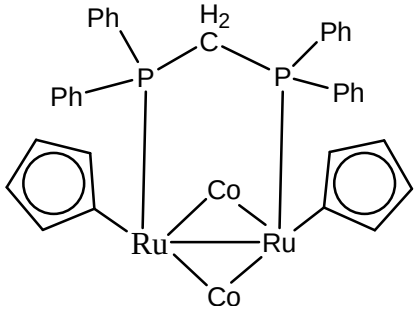
Hence, total number of signal is 3.
Correct option is (c)

24. $[H_3]^+ \rightarrow H{-}H + H^+$ 

Each bond angle is 60º.
Correct option is (c)

25. T.V.E. = 8×2 + 5×2 + 2×2 + 4 = 34 = A
B = (n×18) – A = 36–34 = 2

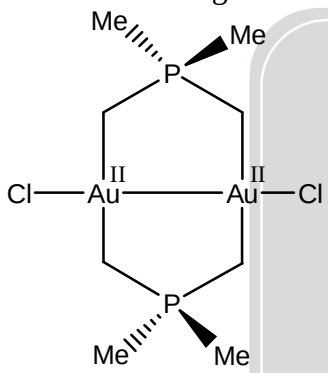
Number of M-M bonds = $\frac{B}{2}=\frac{2}{2}=1$

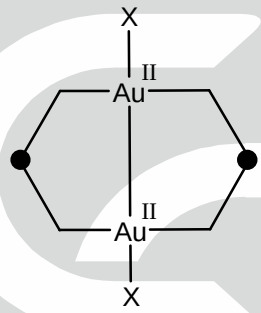


3 - bridging, 1-M-M bonds

Correct option is (c)

26. Oxidation state of gold in this complex is 2





[House Craft Page 1104-1106]

Au^{II} in +2 oxidating state

Correct option is (c)

27. When the norbornene is strained molecule because the hyberdization is sp^2 when the metal attached with norbornene back π-bonding takes place and due to this back π-bonding the hyberdization changes to sp^2–sp^3 and hence relief to strain.

Correct option is (a)

28. According to Nephelauxetic series

$F^- > H_2O > NH_3 > en > NCS^- > Cl^- \sim CN^- > Br^-$

The highest value of β is for F^-

Correct option is (d)

29. The $^2E_g \leftarrow {}^4A_{2g}$ transition in the electronic spectrum of $\left[Cr\left(NH_3\right)_6\right]^{3+}$ occurs nearly at 650 nm.

Correct option is (a)

30. In carbonic anhydrase OH group first attack on CO_2 and then CO_2 intract with Zn.

Correct option is (a)

31. Due to more acidity of HCl it will undergo more ionization. Hence, concentration of $\left[Cl^-\right]_{aq}$ will be maximum.

Correct option is (c)

32. In d.c polarography supporting electrolyte is taken in excess, so that all migration current is carried by suporting electrolyte. Thus electroactive species remain free from migration current
1. $E_{1/2}$ does not depend on concentration of electroactive species.
2. DME is a micro electrode.
3. limiting current is sum of diffusion current and residual current
$i_l = i_d + i_r$

Correct option is (d)

33. Saturation factor in neutron activation analysis.

Activity equation, $A = N\sigma\phi\left[1 - e^{(-\lambda t_{irr})}\right]$

$\left[1 - e^{(-\lambda t_{irr})}\right]$ = saturation factor

$$\text{Saturation Factor} = \frac{A}{N\sigma\phi}$$

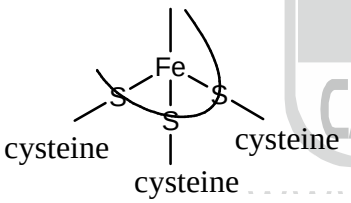
Where, A = number of decays per second
N = number of atoms of the target isotopes
σ = activation cross section
ϕ = neutron flux
λ =decay constant
t_{irr} = irradiation time

Correct option is (a)

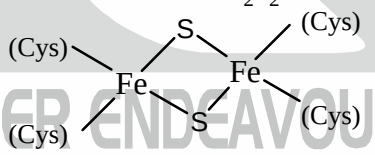
34. Primary analytical method is isotopic dilution mass spectrometry (not using a reference).

Correct option is (d)

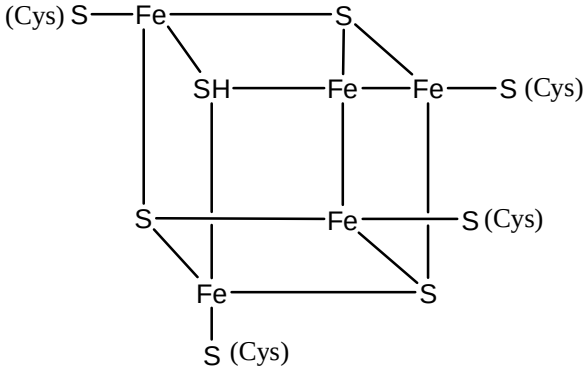
35. Ruberdoxin cysteine



2-iron ferredoxin Fe_2S_2



4-iron ferredoxin



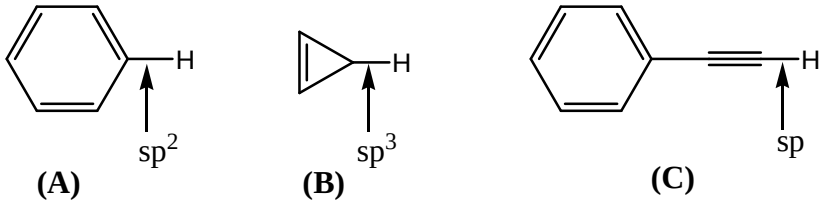
Number of inorganic sulfur (sulfide) which do no belong to protein chain in ruberdoxin, 2-ferredoxin and 4-ferredoxin are 0, 2, 4 respectively

Correct option is (a)

36. LaI_2 exists as $La^{3+}\left(2I^-\right)\left(e^-\right)$

The electron present is responsible for metallic cluster and high electrical conductivity.

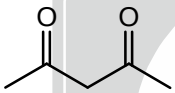
Correct option is (c)

37. 

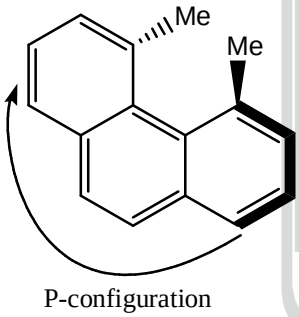
(A) **(B)** **(C)**

More s % character, stronger will be the bond.
More strong bond required more bond dissociation energy. So, the correct order of bond dissociation energy, C > B > A.
Correct option is (d)

38. • Cyclic β-diketones are more acidic than open chain β-diketones
• As the ring decreases, acidity increases

(B) > (A) > (C)  Least acidic

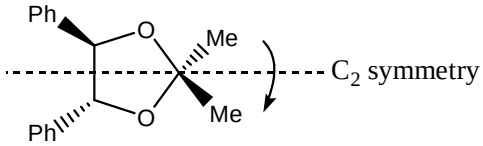
Correct option is (c)

39. 

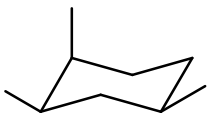
(chiral)

P-configuration

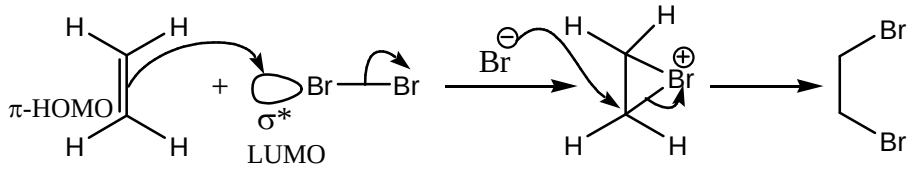
Helical chirality, P-configurations. Since, clockwise path from front side.
Correct option is (a)

40. 

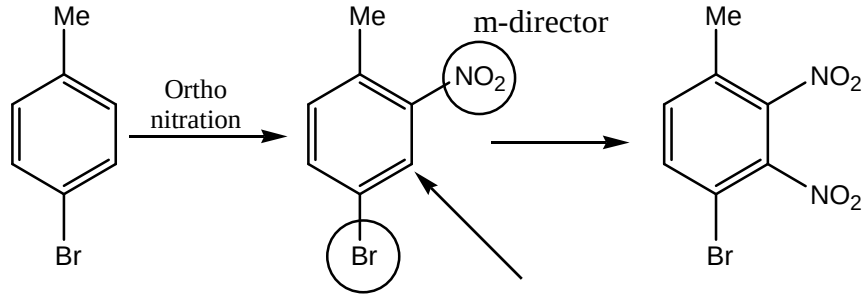
Homotopic
Correct option is (a)

41. 

All three methyl groups on same side (above). But in **option(a)** : 1, 3-diaxial interaction occurs. So, it is less stable conformation. It undergoes ring flipping to give more stable conformation as shown in **option (c)**
Correct option is (c)

42. 

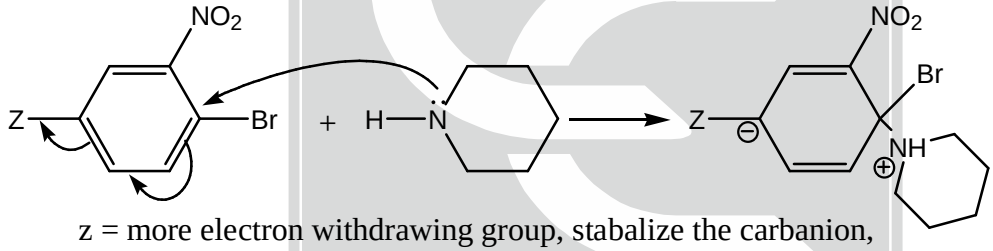
Correct option is (a)

43. 

ortho, para director

When m-directing group is meta to the ortho, para directing group, then incoming electrophiles goes ortho to the m-directing group.

Correct option is (b)

44. 

z = more electron withdrawing group, stabalize the carbanion, more will be rate constant.

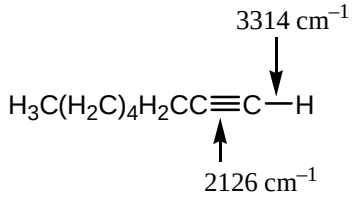
Electron Withdrawing Effect : $CF_3 > CH_3 > OMe$

Correct option is (a)

45.

C_6H_6	:	$CH_3–CN$
6H		3H
1 equivalent	:	2 equivalent
6H		6H
1	:	1 (Integration ratio)

Correct option is (c)

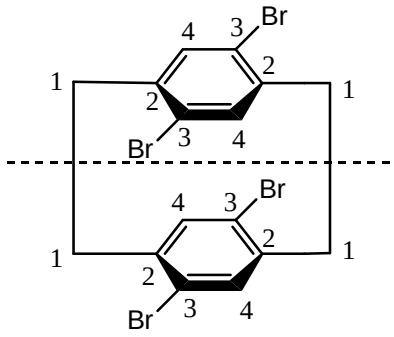
46. 

C≡C 2126 cm^{-1}

C≡C–H 3314 cm^{-1}

Correct option is (c)

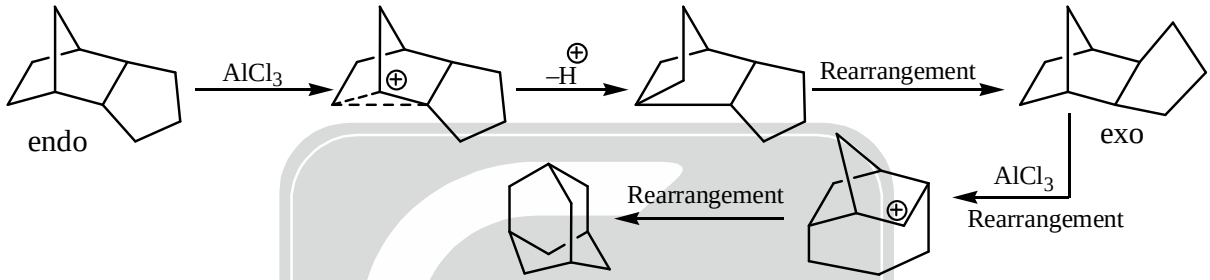
47.



Molecule have plane of symmetry. So, in ^{13}C NMR four signal.

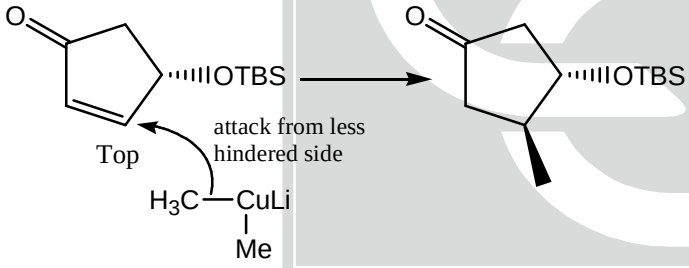
Correct option is (a)

48.



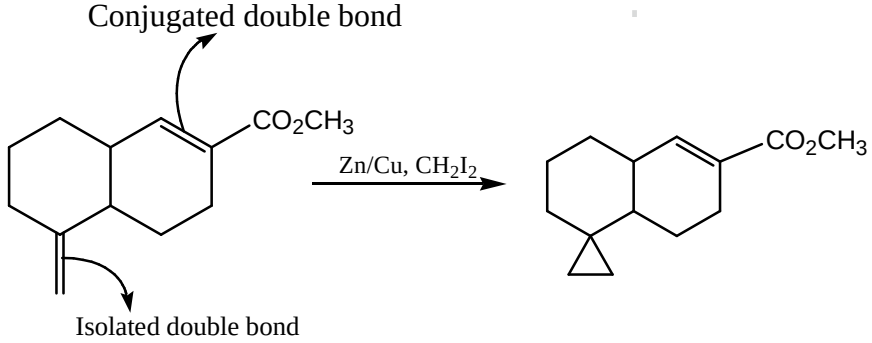
Correct option is (a)

49.



Correct option is (b)

50.

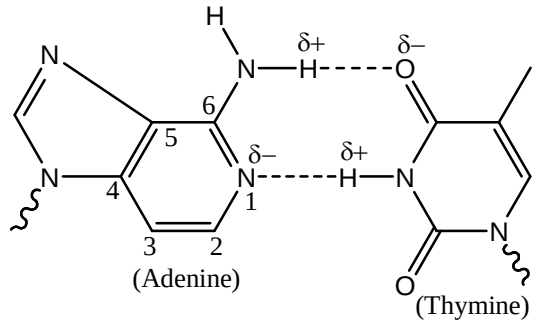


Simmons Smith reaction.

Simmons Smith reagent reacts on isolated double bond, to form a cyclopropane.

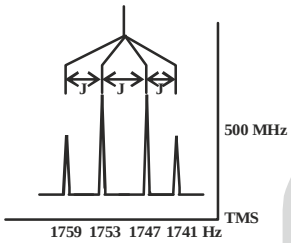
Correct option is (d)

51.



Correct option is (b)

52.



Chemical Shift $\delta = \dfrac{1759+1753+1747+1741}{4} = \dfrac{1750\ \text{Hz}}{500\ \text{MHz}} = 3.5\ \text{ppm}$

Coupling Constant $J = 1747 - 1741 = 6\ \text{Hz}$ or difference between any two adjacent peaks (coupling constant is not change in Hertz).

Correct option is (a)

53. $\uparrow\uparrow\downarrow\downarrow\downarrow$ total spin ½ particle

Weight of configuration = ${}^{5}C_{3} = \dfrac{\lfloor 5}{\lfloor 3 \lfloor 2} = \dfrac{5\times 4\lfloor 3}{\lfloor 3 \lfloor 2} = 10$

Correct option is (d)

54. $\ln\left(\dfrac{k_2}{k_1}\right) = \dfrac{E_a}{R}\left[\dfrac{T_2 - T_1}{T_1 T_2}\right]$

$$\ln\left(\frac{k_{600}}{k_{300}}\right) = \frac{49.8\times 1000\ J\ mole^{-1}}{8.3\ J\ mole^{-1}K^{-1}}\left[\frac{(600-300)K}{300K\times 600K}\right] = 10$$

$$\Rightarrow \quad \frac{k_{600}}{k_{300}} = e^{10}$$

Correct option is (d)

55. Covariance shows the tendency in the linear relationship between the variables.

If $y = f(x) \propto x^n$ (where n > 1), then $\text{cov}(x, y) = +\text{ve}$

If $y = f(x) \propto x^n$ (where n < 0), then $\text{cov}(x, y) = -\text{ve}$

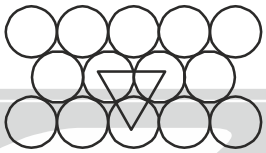
If $y = f(x) \propto x$, then $\text{cov}(x, y) = 0$

For options (a), (b) and (d), $y \propto x^2 \Rightarrow \text{cov}(x, y) = +\text{ve}$

For option (c), $y \propto x \; \text{cov}(x, y) = 0$

Correct option is (c)

56. From figure it is clear that each void is surrounded by three circles.



Correct option is (b)

57. $t_+ = \dfrac{u_+}{u_+ + u_-}$

$u_+ = 6\times10^{-4} \quad u_- = 5\times10^{-4}$

$t_+ = \dfrac{6\times10^{-4}}{6\times10^{-4} + 5\times10^{-4}} = \dfrac{6}{11} = 0.545$

$t_- = 1 - t_+ = 1 - 0.545 = 0.455$

Correct option is (a)

58. $AlCl_3 \rightarrow Al^{+3} + 3Cl^{-1}$

0.008 0 0

0 0.008 0.024

$KCl \rightarrow K^+ + Cl^-$

0.005 0 0

0 0.005 0.005

$I = \dfrac{1}{2}\left(C_1Z_1^2 + C_2Z_2^2 + C_3Z_3^2 + C_4Z_4^2\right) = \dfrac{1}{2}\left(0.008(3)^2 + 0.024(1)^2 + 0.005(1)^2 + 0.005(1)^2\right)$

$I = \dfrac{1}{2}(0.072 + 0.024 + 0.005 + 0.005) = 0.053$

Correct option is (b)

59. For normalised wave function, $c_1^2 + c_2^2 + c_3^2 = 1$

$\because \quad \dfrac{1}{3} + \dfrac{1}{2} + \dfrac{1}{6} = 1$

Correct option is (c)

60. In NMR spectroscopy the static magnetic field is used to create population difference between the spin states

Correct option is (c)

61. $dU = +TdS - PdV$

We know that, $dS \geq \frac{dq}{T}$

$$dS \geq \frac{dU + PdV}{T}$$

$$dU + PdV - TdS \leq 0 \qquad \ldots (1)$$

If S & V are constant, then equation (1) becomes

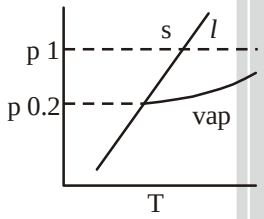
$$(dU)_{S,V} \leq 0$$

Criteria of spontaniety.

Correct option is (a)

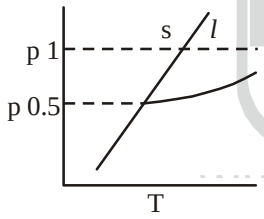
62. Standard condition means 1 bar pressure

For A



So at 1 bar transition will be solid $\rightleftharpoons$ liquid. So number sublimation

For B



Same explanation as above

Correct option is (d)

63. $k = \left(\frac{k_B T}{h}\right) e^{-\frac{\Delta H^{\#}}{RT}} e^{\Delta S^{\#}/R}$

$$\frac{k}{T} = \left[\left(\frac{k_B}{h}\right) e^{\Delta S^{\#}/R}\right] e^{-\Delta H^{\#}/RT}$$

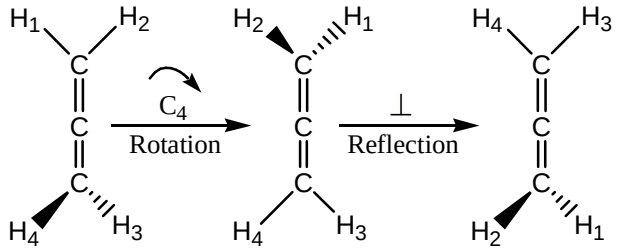
$$\ln\left(\frac{k}{T}\right) = \ln\left[\left(\frac{k_B}{h}\right) e^{\Delta S^{\#}/R}\right] - \frac{\Delta H^{\#}}{R}\left(\frac{1}{T}\right)$$

$y = c + mx$

Correct option is (c)

64. For allowed transition, $\Delta\ell = \pm 1$ and for Lyman Series Transition is from higher level to $n = 1$
Correct option is (b)

65.



Equivalent

Correct option is (b)

66. Given: $V = x^2$

$$\text{Force} = -\frac{\partial v}{\partial x} = -\frac{\partial}{\partial x}x^2 = -2x$$

$$\because \quad V = \frac{1}{2}kx^2 = x^2 \,(\text{given})$$

$$\Rightarrow \quad \frac{1}{2}k = 1 \Rightarrow \; k = 2 = \text{force constant}$$

Correct option is (b)

67. Total surface Area = Number of molecules × Area covered by 1 mole (A_1)

$$100\ cm^2 = \frac{10^{-5}}{602.3} \times 6.023 \times 10^{23} \times A_1$$

$100\ cm^2 \times 10^{-16} = A_1$

$A_1 = 100\ Å_2$

Correct option is (b)

68. In equation, $[\eta] = kM^a$

$[\eta]$ represents intrinsic viscosity

Correct option is (c)

69. Many properties of nano-particles are significantly different than the corresponding bulk material because large ratio of surface area to volume of nono-particles in compare to the bulk.
Correct option is (c)

70. Camphor $\rightarrow$ Terpene
Insulin $\rightarrow$ Hormone
Keratin $\rightarrow$ Structural Protein
Correct option is (b)

PART – C

71. $8C\,(\text{graphite}) + K^+(am) + e^-(am) \rightarrow \left[K\,(am)\right]^+ \left[C8\right]^-(s)$

Due to the presence of unpaired electrons in π^* band of graphite it is paramagnetic and its electrical conductance increases. It has eclipsed layer structure

Correct option is (d)

72. $6S_2Cl_2 + 16NH_3 \xrightarrow{CCl_4 \text{ or } C_6H_6} S_4N_4 + S_8 + 12NH_4Cl$

Correct option is (a)

73. $Ce\left(NO_3\right)_4\left(OPPh_3\right)_2$

$Ce^{4+} \rightarrow 4f^0 \rightarrow \text{No}$ f – f Transition

N_D unpaired electrons.

It is diamagnetic and its colur is due to LMCT. Its C.N. = 10

Correct option is (c)

74. Statement I $\rightarrow \left[Rh\left(CO\right)_2 I_2\right]^-$

Converts CH_3–I and CO into CH_3COI

Statement $\rightarrow \left[Rh\left(CO\right)_2 I_2\right]^-$ is diamagnetic in nature.

I and II are correct but II is not correct explanation of I.

Correct explanation : Monsanto process occurs via oxidative reaction, migratory insertion and reductive elimination reaction for that the starting compound must be square planar.

Correct option is (b)

75. In 30mg sample the overall activity is 3000 s^{-1}. So, mass of $^{12}PO_4^{-2}$ is

$3100 \times m = 3000 \; m = \frac{3000}{3100} = \frac{30}{31}$

$n_A = n_B R_{AB} \Rightarrow \frac{m_A}{\text{molar mass}} = \frac{m_B}{\text{molar mass}} \times R_{AB}$

R_{AB} = Ratio of A and B in sample $m_A \approx m_B \times m_{AB}$

Out of 30 mg $\frac{30}{31}$ mg in B

So, $\left(30 - \frac{30}{3}\right)$ is A

Mass of A = $30\left(1 - \frac{1}{31}\right) = 30 \times \frac{30}{11}$

$R_{AB} = \frac{\text{mass of A}}{\text{mass of B}} = \frac{30 \times \frac{30}{31}}{\frac{30}{31}} = 30$

$m_A = 2 \times 30 = 60\ mg$

Out of 1g amount of PO_4^{-3} in 60 mg.

So, % $PO_4^{-3} = \frac{60}{1000} \times 100 = 6\%$

Correct option is (b)

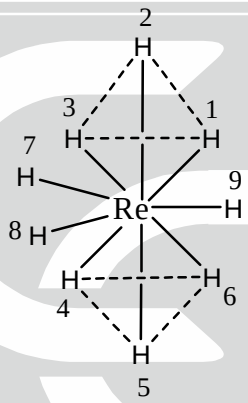
76. $FeO_4^{4-} \rightarrow$ Jahn-Teller distorted away from the ideal tetrahedral towards a flatterred structure

Fe^{4+} ⟶ 

it is paramagnetic due to unpaired electron D_{2d} symmetry

Correct option is (c)

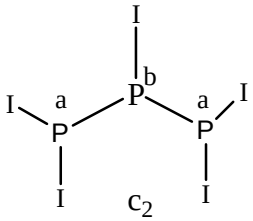
77. $[ReH_9]^{2-} \rightarrow$ Tricapped trigonal prismatic



Atoms 1 to 6 are the prism atoms, 7 to 9 are H-atom are equatorial hydrogen.

Correct option is (a) & (c)

78. Correct structure is



One c_2 axis and one plane of symmetry exist in this molecules.
So, two types of phoshphorous atoms

For $^{a}P = (2NI+1) = \left(2 \times 1 \times \frac{1}{2} + 1\right) = 2\,(\text{doublet})$

For $^{b}P = (2NI+1) = \left(2 \times 2 \times \frac{1}{2} + 1\right) = 3\,(\text{triplet})$

Correct option is (c)

79. $Cl_2 \rightarrow$ solvolysis and disproportionation of Cl_2 in NH_3

$$Cl_2 + 2NH_3 \rightarrow NH_2Cl + NH_4^+ + Cl^-$$

$S_8 \rightarrow$ undergoes disproportionation in liquid NH_3

$$5S_8 + 16NH_3 \rightarrow 4S_4N^- + 4S_6^{2-} + 12NH_4^+$$

CH_3COOH acts as strong acid in NH_3

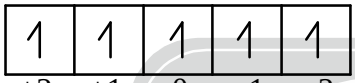
$$CH_3COOH + NH_3 \rightarrow CH_3COO^- + NH_4^+$$

Molecules that do not behave as acid in water, may behave as weak acids in NH_3.

$$H_2NCONH_2 + NH_3 \rightleftharpoons NH_4^+ + NH_2CONH^-$$

Correct option is (d)

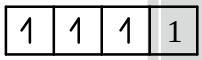
80. $\left[Mn(H_2O)_6\right]^{2+} \rightarrow H_2O$ is a weak ligand, No pairing occurs.

$Mn^{2+} \longrightarrow$ 

$S = 5,\ 2S+1 = 6$

$L = 0 \rightarrow 5$ Term

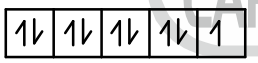
$\therefore$ Ground state term $\rightarrow {}^6S$

$Cr^{3+} \longrightarrow$ 

$L = 3 \rightarrow F$ Term

$$S = \frac{3}{2}\ 2S+1 = 2\times\frac{3}{2}+1 = 4$$

Ground state term $\rightarrow {}^4F$

$Cu^{2+} \longrightarrow$ 

$L = \sum |M_L| = 2 \rightarrow D$

$$S = \frac{1}{2},\ 2S+1 = 2$$

Ground state term $\rightarrow {}^2D$

Correct option is (b)

81. Co-enzyme B_{12} catalyses dehydration, 1, 2-carbon shift reaction.
Hence, **correct option is (b)**

82. Metallothionines $\rightarrow$ Cystein rich protein
Plastocyanin $\rightarrow$ Electron Transfer
Ferritin $\rightarrow$ Iron storage
Chemotherapy $\rightarrow$ Carboplatin
Correct option is (c)

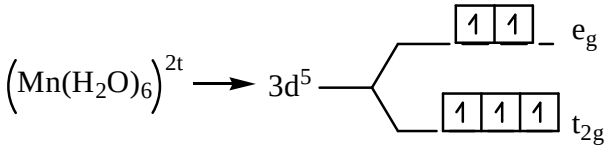
83. $\left[CO(NH_3)_5Cl\right]^{2+} + OH^- \rightleftharpoons \left[CO(NH_3)_4(NH_2)Cl\right]^{+} + H_2O$ ... (i)

$\left[CO(NH_3)_4(NH_2)Cl\right]^{+} \rightarrow \left[CO(NH_3)_4(NH_2)\right]^{2+} + Cl^-$ ... (ii)

$\left[CO(NH_3)_4(NH_2)\right]^{2+} + HOH \rightarrow \left[CO(NH_3)_5(OH)\right]^{2+}$

Correct option (b)

84. Heme A $\rightarrow$ Iron porphyrin $\rightarrow$ Colour due to $\pi - \pi^*$ water splitting enzyme contains transition 0×0 bridged Mn_4 cluster



Spin forbidden transitions

$\left[Cr(H_2O)_6\right]^{2+} \rightarrow t_{2g}^3 eg^1 \rightarrow$ Tetragonal elongation.

Correct option is (b)

85. $Co(CO)_3$

9 + 6 = 15 (for 18 electron require 3 electron)

$P \leftrightarrow BH_2$

$5 \quad 3+2=5$ (for 8 electron require 3 electron)

$CH \quad \leftrightarrow \quad BH_2$ (for 8 electron require 3 electron)

$4+1=5 \quad 3+2=5$

$Ni\left(\eta^5 - C_5H_5\right)$ (for 18 electron require 3 electron)

$10+5=15$

$Co(CO)_3 \leftrightarrow P \leftrightarrow CH \leftrightarrow Ni\left(\eta^5 - C_5H_5\right)$

Correct option is (b)

86. $\left[Co\left(\eta^5 - C_5H_5\right)B_4H_8\right]$

$Co\left(\eta^5 - C_5H_5\right) \longleftrightarrow (BH)$

$14 \qquad 4$

$\left[BHB_4H_8\right] = \left[B_5H_5\right]^{-4} \equiv \left[BnHn\right]^{-4} \rightarrow$ nido

$\left[Mn\left(\eta^2 - B_3H_8\right)(CO)_4\right]; \quad \left[Mn(CO)_4\right] \longleftrightarrow \left[BH_2\right]$

$7+8=15 \qquad 5$

$\left[B_3H_8BH_2\right] = \left[B_4H_{10}\right] = \left[B_4H_4\right]^{-6} \equiv \left[BnHn\right]^{-6} \rightarrow$ Arachno

Correct option is (b)

87. $\left[Rh_6C(CO)_{15}\right]^{2-}$

TVE = 9×6 + 4 + 15×2 + 2 = 54 + 4 + 2 + 30 = 90

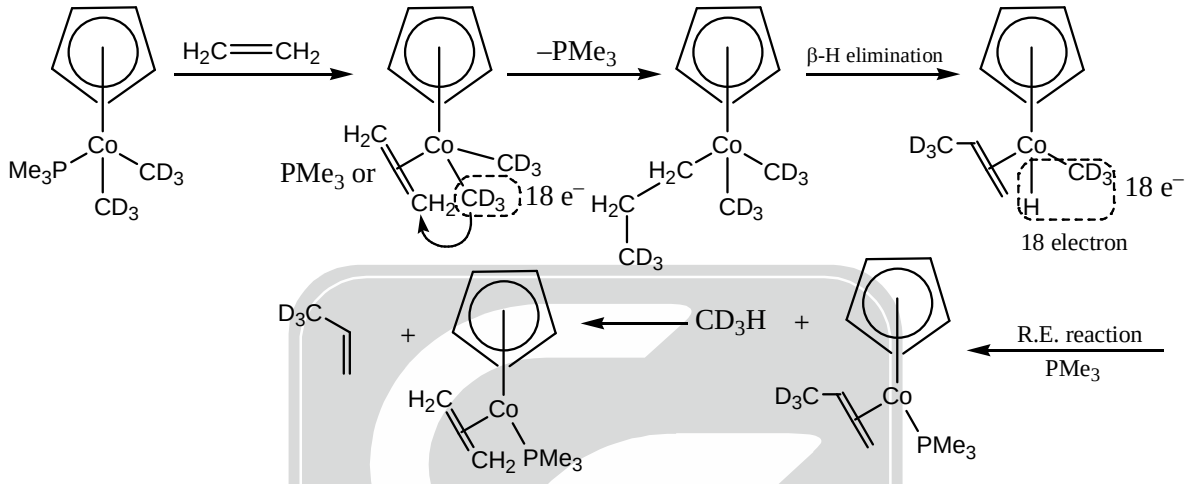
Hence, it has trigonal prism geometry.

Correct option is (c)

88. $B_4H_{10} + NMe_3 \rightarrow Me_3NB_3H_7 + Me_3NBH_3$

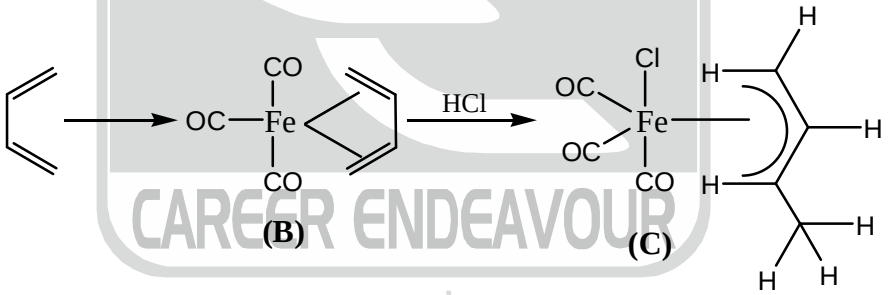
Correct option (a)

89.



Correct option is (c)

90. $Fe(CO)_5$ +



Compound (C) has show four ^1H NMR signal

Correct option is (b)

91. $k_{12} = \left(k_{11}\ K\ k_{22}f\right)^{1/2} = \left(5\times4\times10^3\times2\times10^8\times1.0\right)^{1/2} = 20\times10^5 = 2.0\times10^6$

Correct option is (b)

92. Fischer carbene carbon is electrophilic in nature due to strong π-acceptor ligands

Correct option is (a)

93. (A) trimethylamine $\rightarrow pK_a$ 9.8

(B) dimethylamine $\rightarrow pK_a$ 10.8

(C) methyl amine $\rightarrow pK_a$ 10.6

pH > 7 is a basic pH and amine with lower pK_a value will give the proton easily, and will elute at last.

Correct option is (a)

94. Number of hyperfine line (due to Cu and nitrogen)

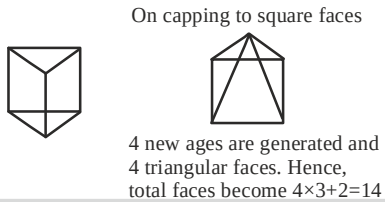
$(2NI_{Cu}+1)$ $(2NI_{N}+1)$

$\left(2\times1\times\frac{3}{2}1\right)$ $(2\times2\times1+1)$

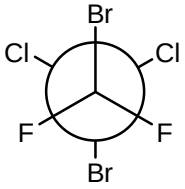
$4\times5=20$

Correct option is (a)

95. Number of triangular anti-prism are 8, in icosahedron it is 20 and in tricapped trigonal prism capped on square faces) it is 14

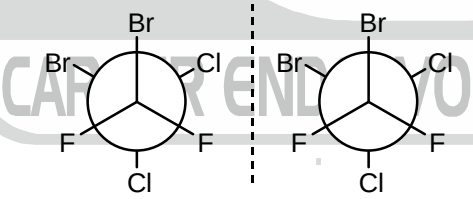


Correct option is (a)

96. 

Both fluorine in same environment.

So, form doublet $(2NI_{F}+1)=\left(2\times1\times\frac{1}{2}+1\right)=2$



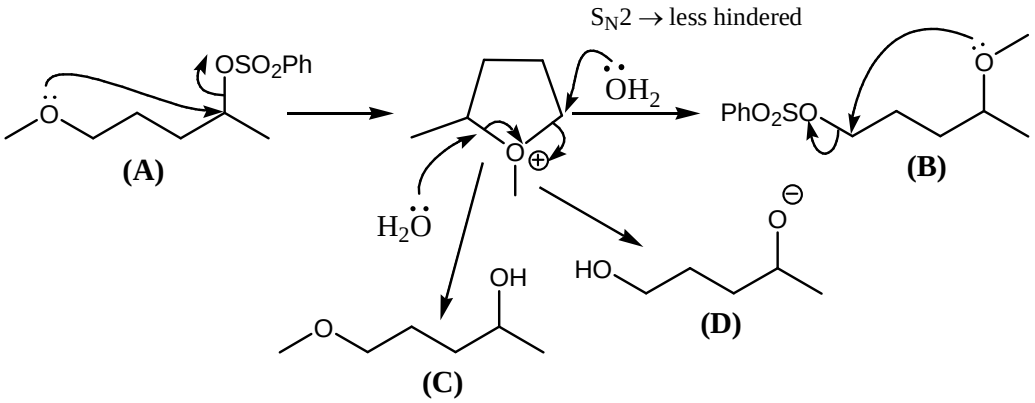
Both are mirror image to each other but flourine in different environment

$\left(2\times2\times\frac{1}{2}+1\right)=3$ triplet

So, total number of line = 2+ 3 = 5

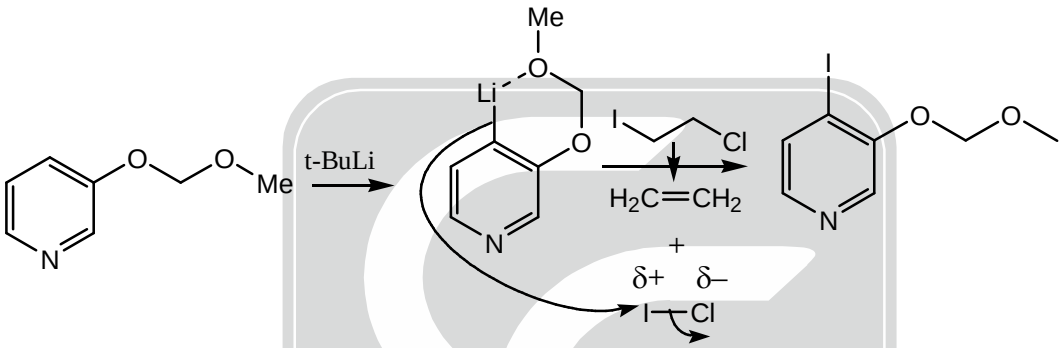
Correct option is (d)

97.



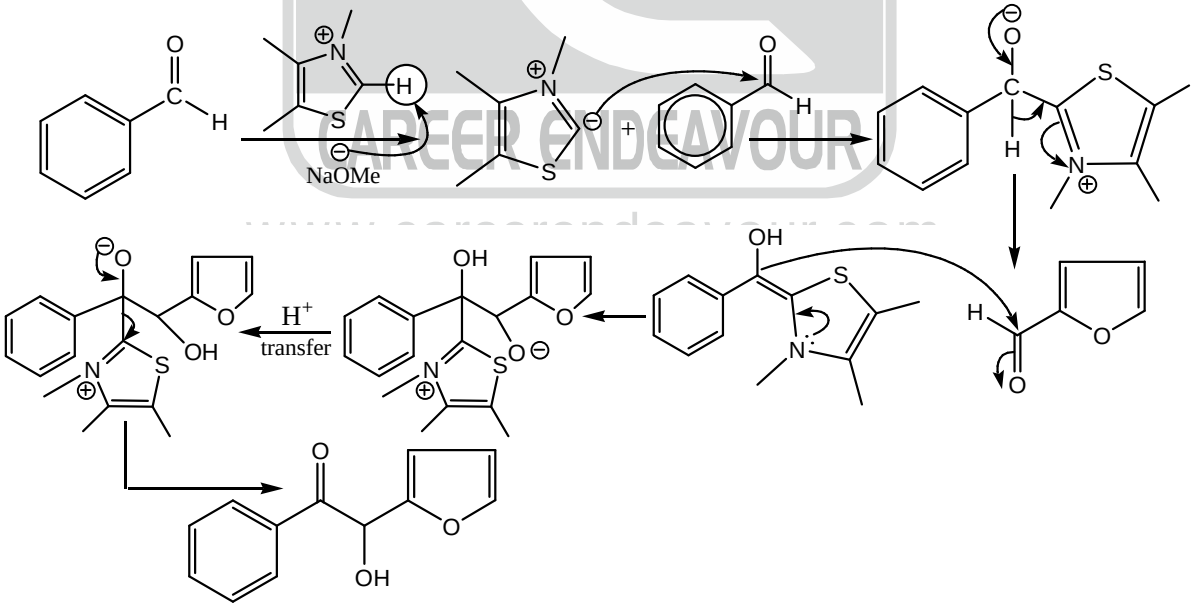
Correct option is (c)

98.



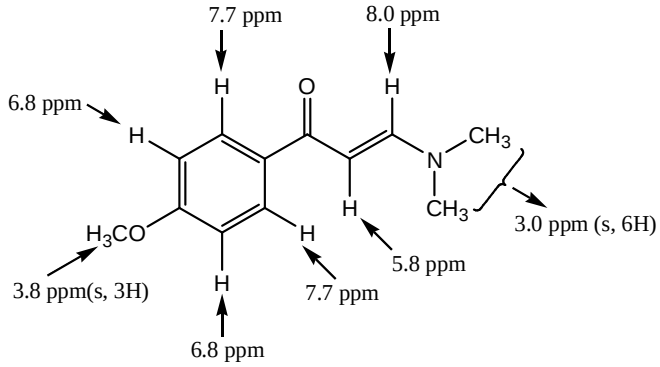
Correct option is (c)

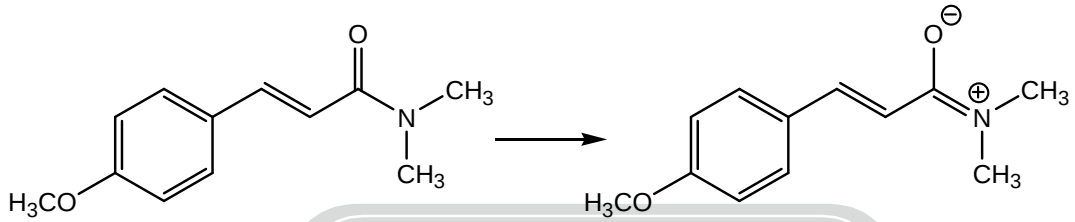
99.



Correct option is (b)

100.



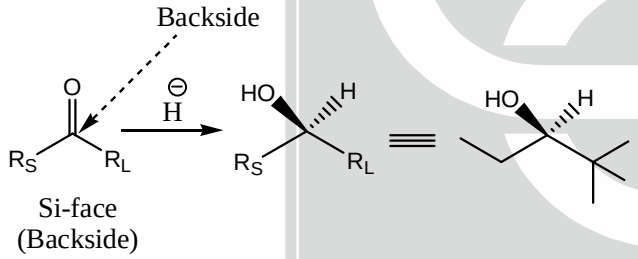


(More stable structure)

Spectral data confirms the Para-pattern, so option (a) and (b) ruled out. Options (c) and (d) may be correct but in option (d), the methyl are non-equivalent due to resonating structure, exhibit different signal. But in option (c), two methyl group are chemical equivalent and exhibits a singlet of 6-Hs

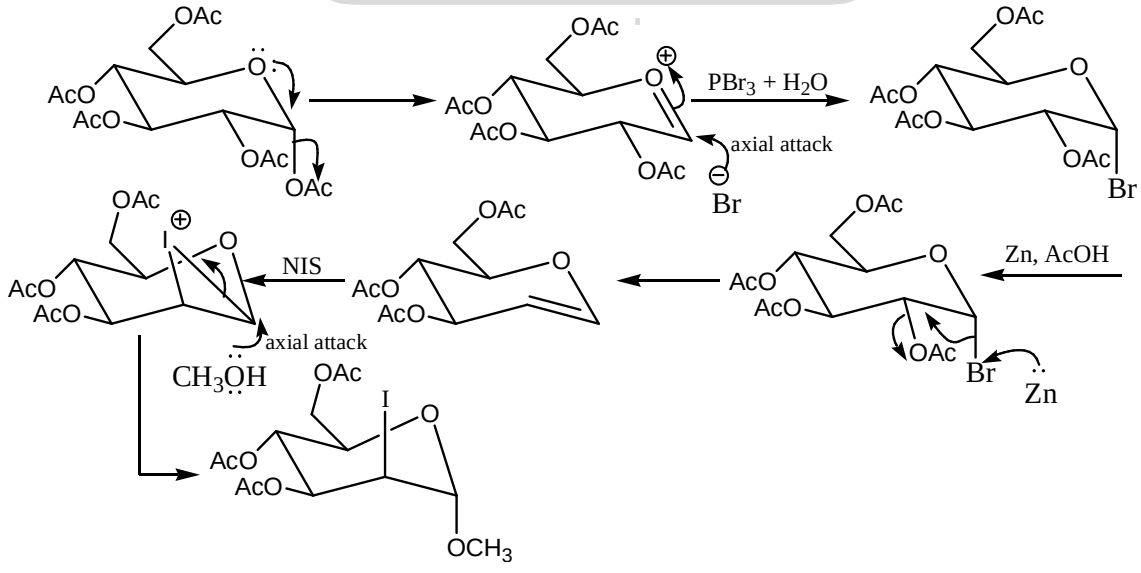
Correct option is (c)

101.



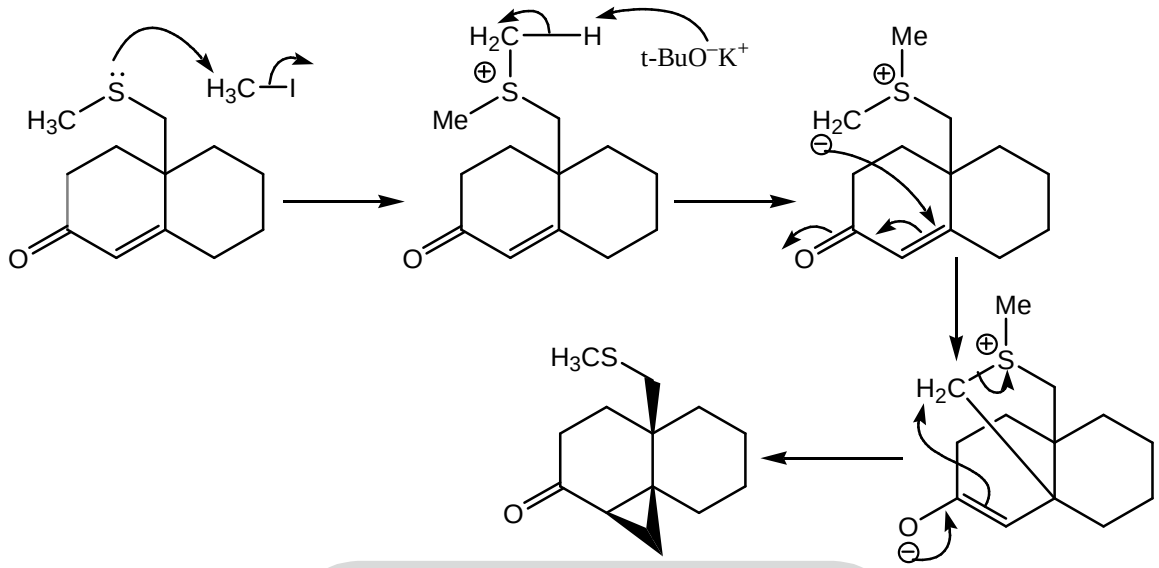
Correct option is (d)

102.



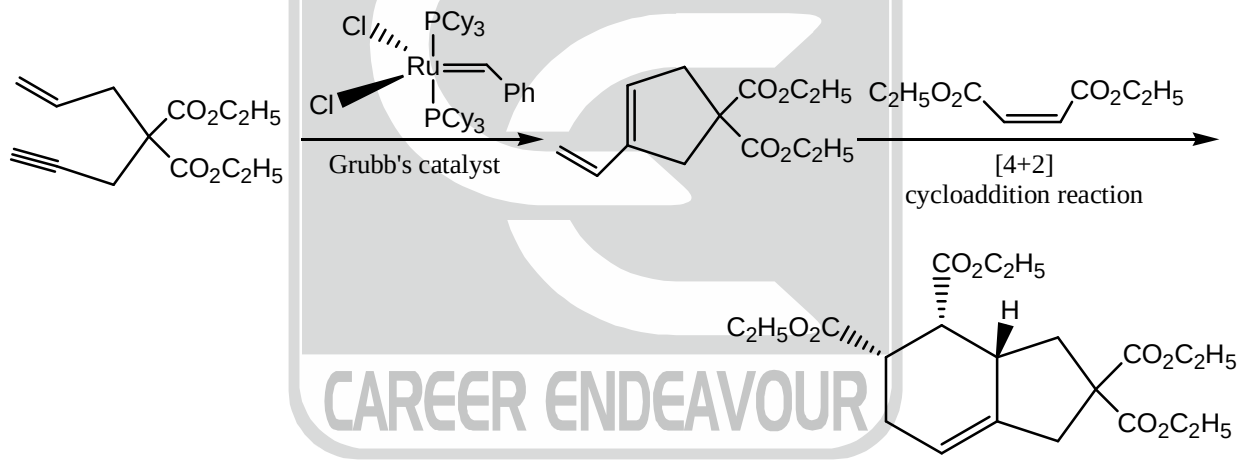
Correct option is (b)

103.



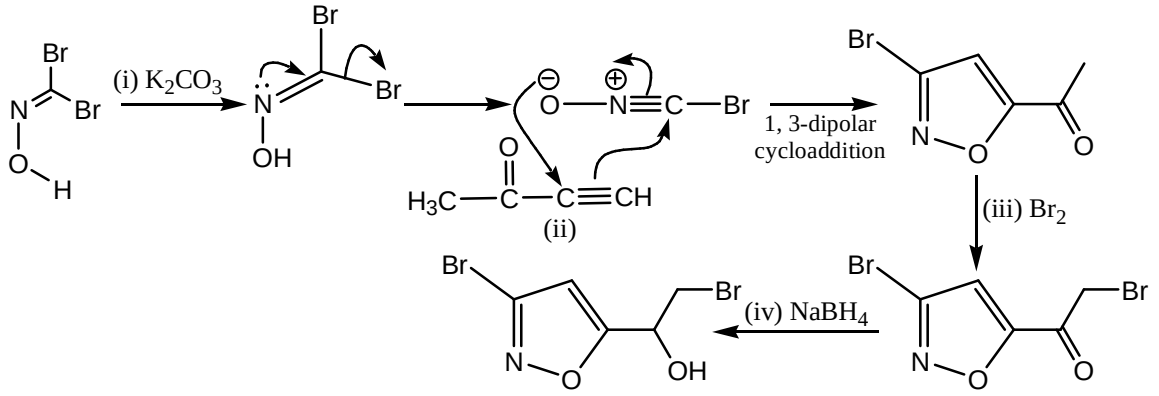
Correct option is (b)

104.



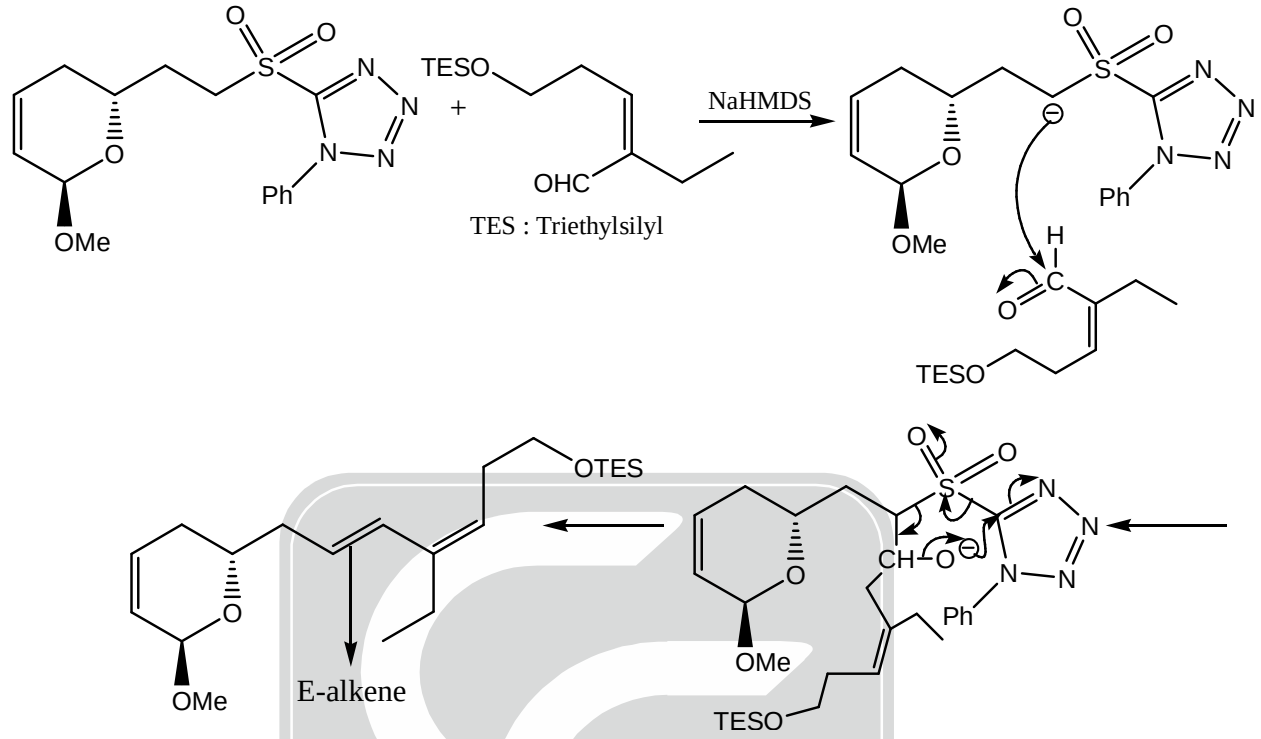
Correct option is (a)

105.



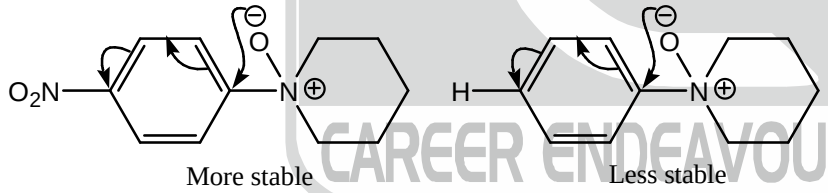
Correct option is (a)

106. This is Julia Olefinations reactions, under the given set of reaction E-alkene is formed. The detail mechanism is shown below.

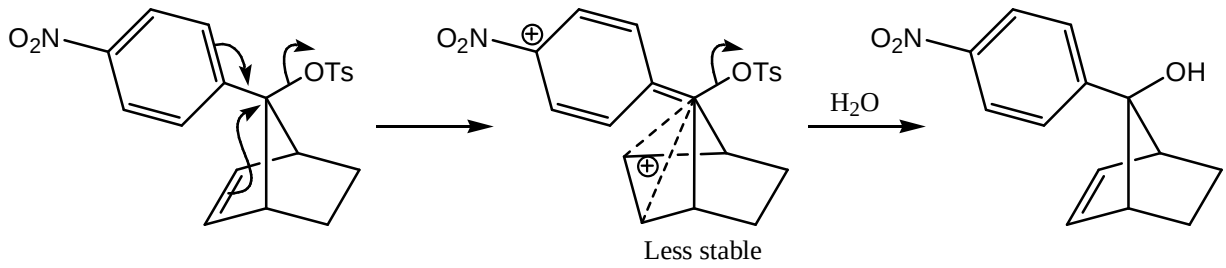


Correct option is (b)

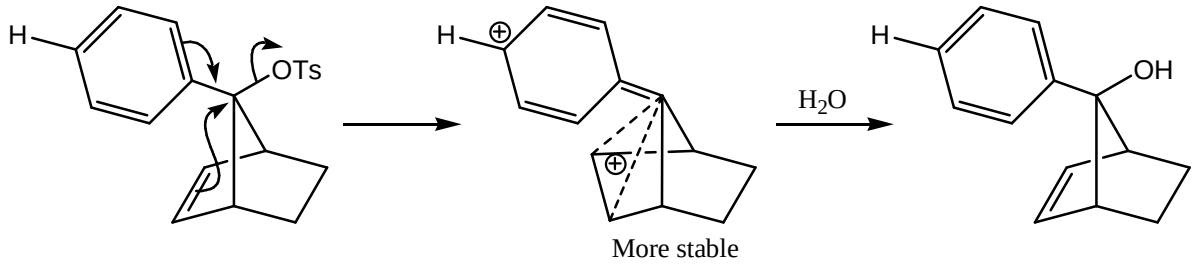
107.



–R effect of this group, increase stability of intermediate.
In that case electron withdrawing group increase the rate of reaction.

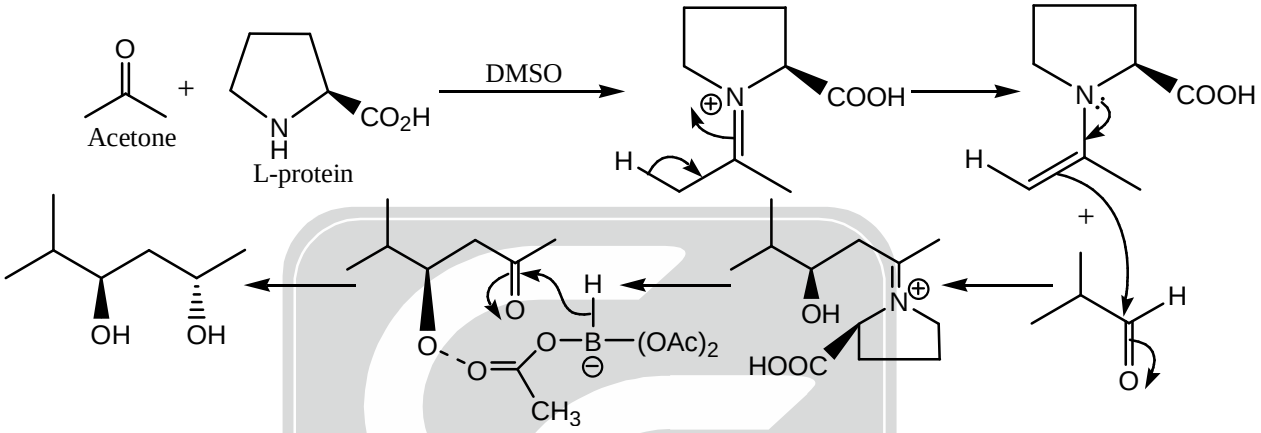


EWG containing carbocation intermediate decrease the stability.



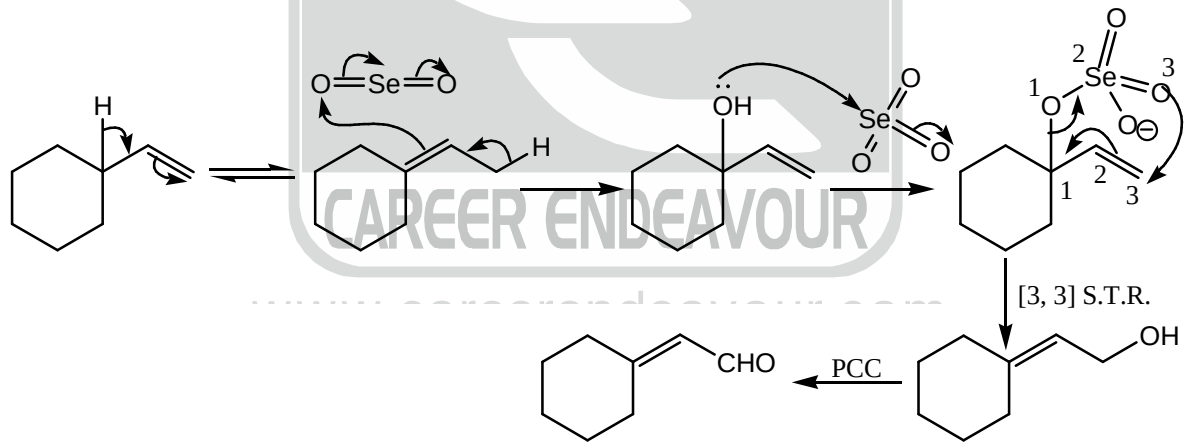
Correct option is (d)

108.



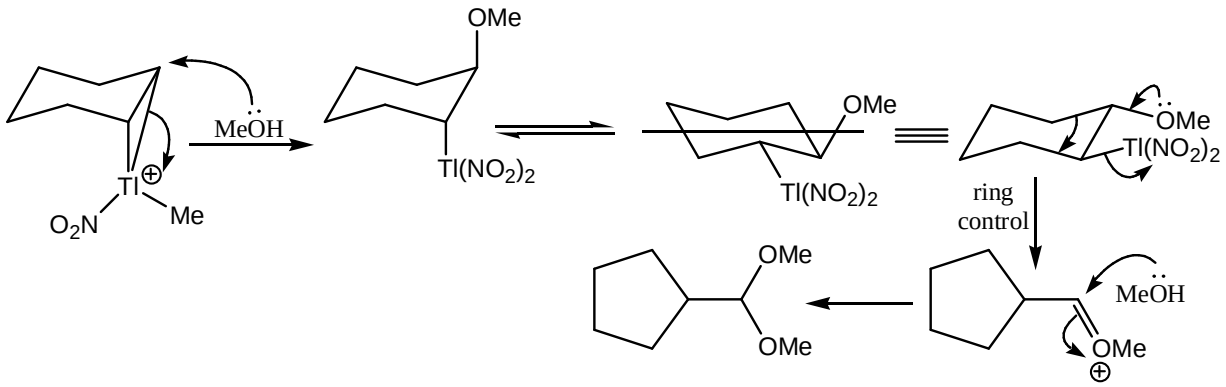
Correct option is (a)

109.



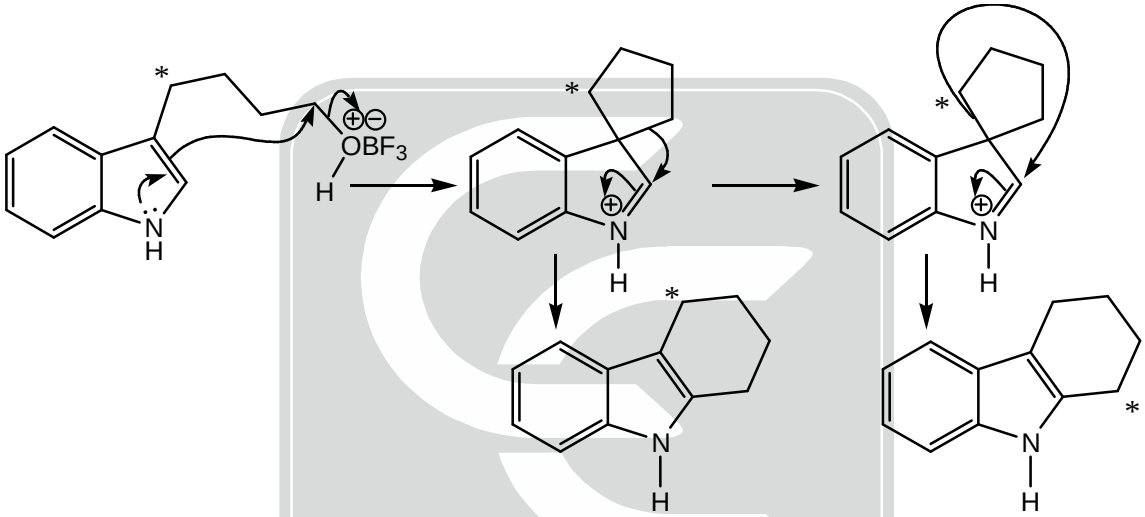
Correct option is (a)

110.



Correct option is (b)

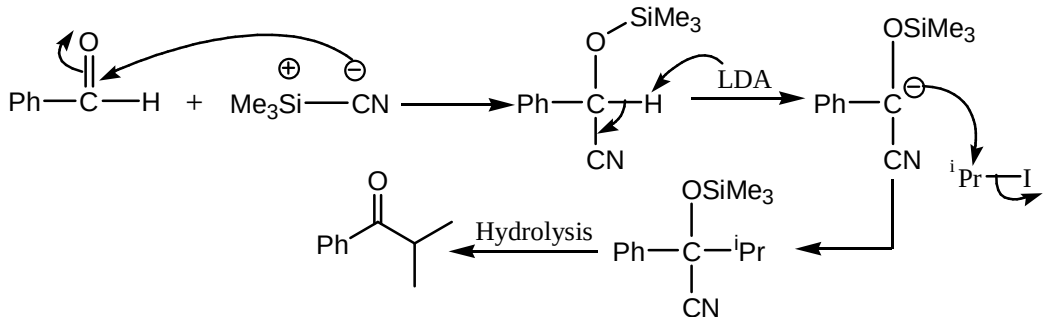
111.



Correct option is (c)

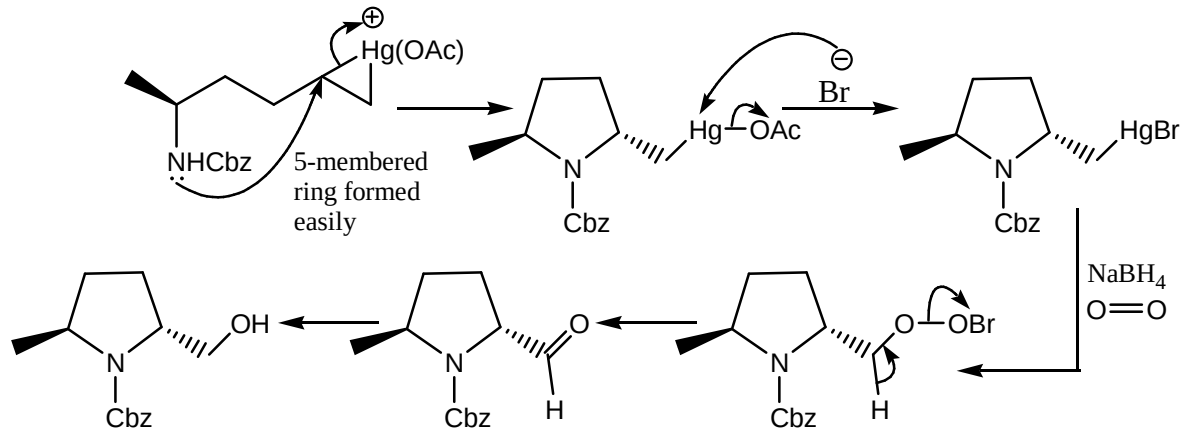
112. **Coupling reaction**
Correct option is (a)

113.



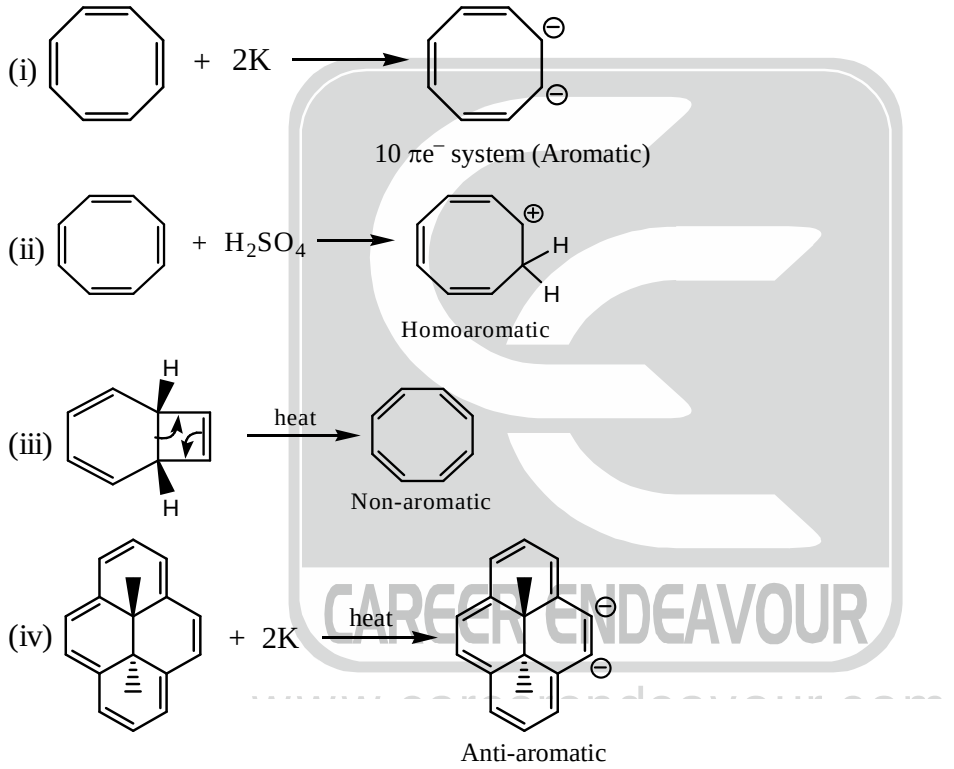
Correct option is (d)

114.



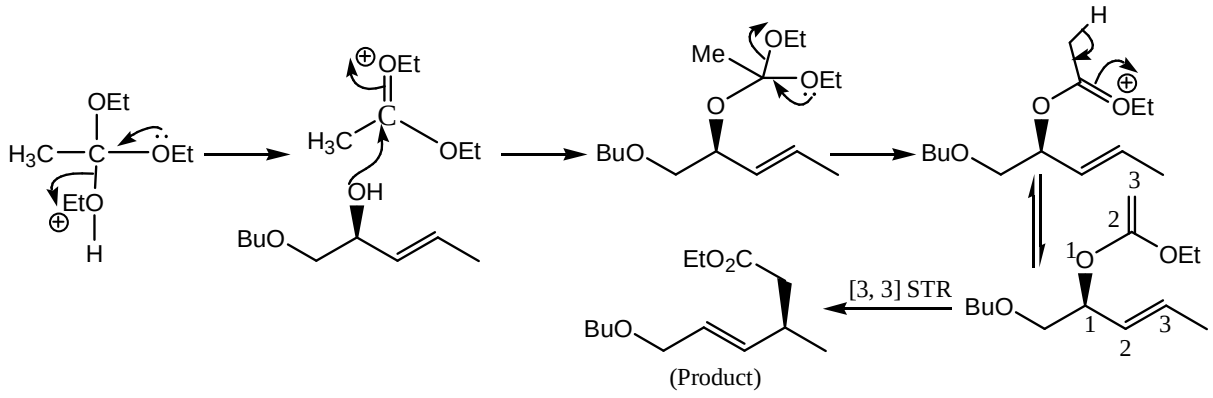
Correct option is (d)

115.



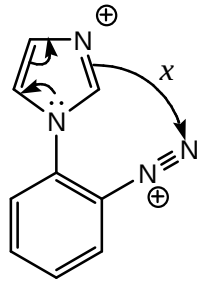
Correct option is (a)

116.



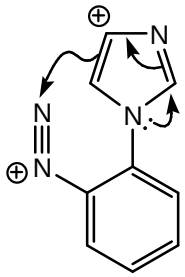
Correct option is (b)

117.



Less stable resonating structure

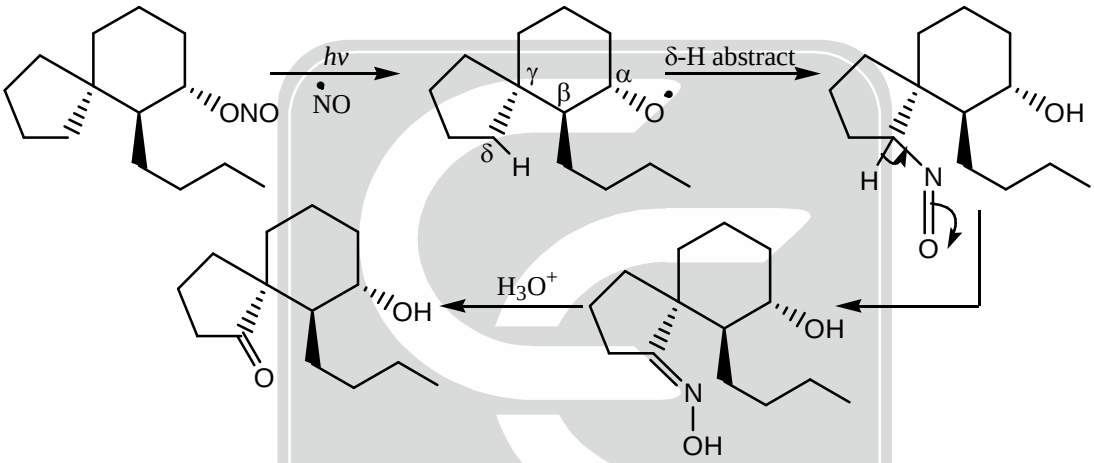
+ve charge comes on both 'N' atom
(Less stable resonating structure)



Positive charge comes on one nitrogen atom
(More stabilized resonating structure)

Correct option is (b)

118. **Barton reaction :**

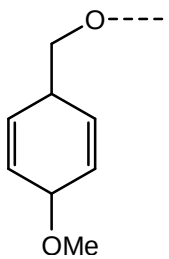


Correct option is (a)

119.

Correct option is (b)

120. DDQ used for deprotection of benzylether through one electron oxident process. As the number of –OMe increases on the aryl ring, reactivity towards deprotection increases. So,



removed to give Alcohol.

Correct option is (d)

121. $\hat{H} = \hat{H}_0 + a\,\vec{L}\cdot\vec{S}$

For constant of motion C, we must have

$\left[C, \hat{H}\right] = 0$

Here, $\left[\vec{L}+\vec{S}, \hat{H}\right] = 0$ and $\left[\vec{L}+\vec{S}\right] \neq 0 \neq \left[\vec{S}, \hat{H}\right]$, $\left[\vec{L}, \vec{S}, \hat{H}\right] \neq 0$

Correct option is (c)

122. $E = -13.6\frac{Z^2}{n^2} \Rightarrow -13.6\times\frac{25}{n^2} = -13.6 \Rightarrow n = 5$

Therefore, orbital degeneracy = $n^2 = 25$.

Correct option is (c)

123. $\because$ $\psi = \hat{A}\phi$ is normalised

$\therefore$ $\int\left(\hat{A}\phi\right)^{\dagger}\left(\hat{A}\phi\right)d\tau = 1$

$\Rightarrow$ $\int \phi^{\dagger}A^{\dagger}A\phi\, d\tau = 1 \quad \Rightarrow \int \phi^{\dagger}\phi d\tau = 1$

Therefore, ϕ will be normalised if $A^{\dagger}A = 1$

$\Rightarrow$ A is unitary

Correct option is (c)

124. According to Perturbation theory, "The energy of perturbed system is equal or greater than the standard system".

Correct option is (*)

125. $1\sigma_g(1)\ 1\sigma_u(2) - 1\sigma_g(2)1\sigma_u(1)$

$= \left[\left(\psi_{1s(H_a)}(1) + \psi_{1s(H_b)}(1)\right)\left(\psi_{1s(H_a)}(2) - \psi_{1s(H_b)}(2)\right)\right]$

$= \left[\psi_{1s(H_a)}(2) + \psi_{1s(H_b)}(2)\right]\left[\psi_{1s(H_a)}(1) - \psi_{1s(H_b)}(1)\right]$

$= 2\left[\psi_{1s(H_a)}(2)\psi_{1s(H_b)}(1) - \psi_{1s(H_a)}(1)\psi_{1s(H_b)}(2)\right]$

Correct option is (b)

126. The arrangements for $\left[{}^1\pi_g\right]^1\left[3\sigma_u\right]^1$ configurations are

(I)

m_L	$\uparrow$	σ_u
	0	
	$\uparrow$	$\overline{\pi_g}$
	π_g	
m_L	+1	-1

S = 1, 2S + 1 = 3

L = 1 → π Term

Spectroscopic Term $= {}^3\pi$

(II) m_L $\underset{0}{\overset{\uparrow\downarrow}{\quad}}$ σ_u

$\underset{\pi_g}{\overset{\uparrow}{\quad}}$ $\underset{\pi_g}{\overset{}{\quad}}$

m_L $+1$ -1

$L = 1 \rightarrow \pi$ Term

$S = 0,\ 2S+1 = 1$

Spectroscopic Term $\rightarrow {}^1S$

Thus one of possible moleculer term symbol is ${}^1\pi$

Correct option is (a)

127.

A_1	1	1	1	1
B_1	1	-1	1	-1
$A_1 \times B_1 =$	1	-1	1	$-1 \Rightarrow$ x polarised

Correct option is (b)

128. The polar point group are

C_{nv}, C_n, C_1, Cs

Correct option is (d)

129. $B_{HBr} = 10\ cm^{-1},\ \bar{v}_{HBr} = 2000\ cm^{-1}$

$$B_{PBr} = \frac{H_{HBr}}{2} \text{ and } \bar{v}_{HBr} = \frac{\bar{v}_{HBr}}{\sqrt{2}} \qquad \left\{ \because\ B \propto \frac{1}{\mu} \text{ and } \bar{v} = \frac{2000\ cm^{-1}}{\sqrt{\mu}} \right\}$$

$$\Rightarrow \quad B_{PBr} = \frac{10\ cm^{-1}}{2} = 5\ cm^{-1} \text{ and } \bar{v} = \frac{2000\ cm^{-1}}{\sqrt{2}} = 1410\ cm^{-1}$$

Correct option is (d)

130. N_2O is microwave and rotational Raman active molecule.

Correct option is (b)

131. 200 MHz $\longrightarrow$ 600 MHz

J coupling constant = 10 Hz

Difference in terms of δ-value remains constant.

So, at 600 MHz, 2ppm = 1200 *Hz*. Hence, correct option is **(d)**

132. $dH = TdS + UdP$

S H P

U G

V A T

$$\left(\frac{\partial H}{\partial P}\right)_T = T\left(\frac{\partial S}{\partial P}\right)_T + V$$

Now $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$. So, $\left(\frac{\partial H}{\partial P}\right)_T = -T\left(\frac{\partial V}{\partial T}\right)_P + U$

This is T.E.S. II

Now for given gas

$$P(V-b) = RT \Rightarrow PV - Pb = RT$$

Constant P on differentiating with respect to T

$$P\left(\frac{\partial V}{\partial T}\right)_P - 0 = R \Rightarrow \left(\frac{\partial V}{\partial T}\right)_P = \frac{R}{P} \Rightarrow \left(\frac{\partial H}{\partial P}\right)_T = -T\frac{R}{P} + V$$

now from equation

$$P(V-b) = RT \Rightarrow V - b = \frac{RT}{P} \Rightarrow -\frac{TR}{P} + V = -\frac{TR}{\frac{V-b}{RT}} + V = -V + b + V = b$$

So $\left(\frac{\partial H}{\partial P}\right)_T = b$

Correct option is (b)

133. According to Clapyeron equation

$$\frac{dP}{dT} = \frac{\Delta H}{T\Delta V}$$

if $\Delta V = 0$ (because change in volume is zero)

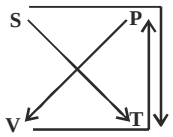
$$\frac{dP}{dT} = \frac{\Delta H}{T(0)}; \quad \frac{dP}{dT} = \infty$$

$\frac{dP}{dT}$ represents the slope of phase diagram.

When $\tan\theta = \infty$

$\theta = 90^o$

Correct option is (a)

134. 

$$\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial P}\right)_T \quad \ldots (1)$$

Now, according to reciprocal theorem of partial derivatives

$$\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial T / \partial V}\right)_P$$

$$\left(\frac{\partial S}{\partial P}\right)_T = \frac{1}{\left(\partial P / \partial S\right)_T}$$

Putting these values in equuation (1), we get

$$\frac{1}{\left(\partial V / \partial T\right)_P} = -\frac{1}{\left(\partial P / \partial S\right)_T} \Rightarrow \left(\frac{\partial P}{\partial S}\right)_T = -\left(\frac{\partial T}{\partial V}\right)_P$$

Or, $\boxed{\left(\frac{\partial T}{\partial V}\right)_P = -\left(\frac{\partial P}{\partial S}\right)_T}$

Correct option is (a)

135. $E_{along} = -\frac{kTBz}{2}$ $E_{ground} = \frac{kTBz}{2}$

$$\left(\frac{n}{N}\right)_{along} = \frac{e^{-E_{along}/kT}}{q} \;\&\; \left(\frac{n}{N}\right)_{ground} = \frac{e^{-E_{along}/kT}}{q}$$

Rate of probability of finding the proton along end against magnetic field

$$\frac{\left(\frac{n}{N}\right)_{a\log}}{\left(\frac{n}{N}\right)_{along}} = \frac{e^{-E_{along}/kT}}{\frac{e^{E_{along}}/kT}{q}} = \frac{e^{-E_{along}/kT}}{e^{-\hbar\gamma Bz}/2kT} = \frac{e^{+\hbar\gamma Bz}/2kT}{e^{-\hbar\gamma Bz/2kT}} = e^{\hbar\gamma Bz/2kT}\; e^{\hbar\gamma Bz/kT} = e^{\hbar\gamma Bz/kT}$$

Correct option is (d)

136. Since, zero point energy = 0

$$\Rightarrow \quad q = \frac{1}{1-e^{-\Delta E/kT}} \quad [\text{Given : } \Delta E = k_B T\,]$$

$$\Rightarrow \quad q = \frac{1}{1-e^{-kT/kT}} = \frac{1}{1-e^{-1}} = \frac{1}{1-\frac{1}{e}} = \frac{1}{\frac{e-1}{e}} \Rightarrow q = \frac{e}{e-1}$$

Correct option is (c)

137. Rate of production of D

$$r = k_2[A][C] \qquad \ldots (1)$$

SSA on 'C',

$$2k_1[A][B] = 2k_{-1}[C]^2 + k_2[A][C] = [C]\left[2k_{-1}[C] + k_2[A]\right]$$

$$[C] = \frac{2k_1[A][B]}{2k_{-1}[C] + k_2[A]} \qquad \ldots (2)$$

$\because \quad k_2[A] << k_{-1}[C]$

$$\therefore \quad (2) \Rightarrow [C] = \left(\frac{k_1}{k_{-1}}\right)^{1/2} [A]^{1/2} [B]^{1/2}$$

$$\therefore \quad (1) \Rightarrow r = k_2 \left(\frac{k_1}{k_{-1}}\right)^{1/2} [A]^{3/2} [B]^{1/2} \quad \text{... (3)}$$

Correct option is (d)

138. $X^+ + Y^{2-} + H^+ \rightleftharpoons \left[XYH^{\#}\right] \rightarrow$ Product

$$\frac{k}{k_0} = \frac{\gamma_{X^+}\ \gamma_{Y^{2-}}\ \gamma_{H^+}}{\gamma_{\left[XYH^{\#}\right]}}$$

$$\log\left(\frac{k}{k_0}\right) = -B\sqrt{I}\left[(+1)^2 + (-2)^2 + (+1)^2 - (0)^2\right]$$

$$= -B\sqrt{I}\left[1+4+1\right]$$

$$= -6B\sqrt{I} \quad \text{... (1)}$$

$$\log\left(\frac{k}{k_0}\right)_1 = -6B\sqrt{I_1} \quad \text{... (2)}$$

$$\log\left(\frac{k}{k_0}\right)_2 = -6B\sqrt{I_2} \quad \text{... (3)}$$

Here, $I_1 = 16$ and $I_2 = 4$

$$(1) - (2) \Rightarrow \log\left(\frac{k_2}{k_1}\right) = -6B\left[\sqrt{I_2} - \sqrt{I_1}\right]$$

$$\Rightarrow \quad \log\left(\frac{k_4}{k_{16}}\right) = -6B\left[\sqrt{4} - \sqrt{16}\right] = -6B\left[2-4\right] = 12B$$

Correct option is (d)

139. Pre-exponential factor in collision Theory, $A \propto \frac{\sigma^2}{\sqrt{\mu}}$

$$\frac{A_2}{A_1} = \left(\frac{\sigma_2}{\sigma_1}\right)^2 \left(\frac{\mu_1}{\mu_2}\right)^{1/2}$$

$$\Rightarrow \quad \frac{A_2^2}{A_1^2} = \left(\frac{\sigma_2}{\sigma_1}\right)^4 \left(\frac{\mu_1}{\mu_2}\right) \quad \text{... (1)}$$

Here, $\sigma_1 = \sigma_2 = 0.4$

$$(1) \Rightarrow \frac{A_2^2}{A_1^2} = \frac{\mu_1}{\mu_2} \quad \text{... (2)}$$

$$\mu_1 = \frac{5\times 20}{25} = 4 \text{ and } \mu_2 = \frac{10\times 10}{20} = 5$$

$$\therefore \quad \left(\frac{A_2}{A_1}\right)^2 = \frac{4}{5}$$

Correct option is (a)

140. $K_{salt} = K_{solution} - K_{water} = \left(1.5\times 10^{-3} - 1.5\times 10^{-5}\right) ohm^{-1}dm^{-1}$

$K_{salt} = 1.5\times 0.99\times 10^{-3}$

$$\text{Solubility(s)} = \frac{K_{salt}}{\Lambda_{salt}}$$

$$s = \frac{\left(1.5\times 0.99\times 10^{-3}\right) ohm^{-1}dm^{-1}}{\left(0.485+1\right) ohm^{-1}dm^2mol^{-1}}$$

$$s = \frac{1.485}{1.485}\times 10^{-3}\frac{mol}{dm^3} \quad \Rightarrow \quad s = 1\times 10^{-3}\frac{mol}{dm^3}$$

$s = 1\times 10^{-3}\times 200\ gm/dm^3 \quad \Rightarrow \quad s = 2\times 10^{-1}\ gm/L \quad \left(\because\ 1dm^3 = 1L\right)$

Correct option is (c)

141. (1) $Zn + 4NH_3 \rightarrow Zn\left(NH_3\right)_4^{2+} + 2e^- \qquad E^0 = 1.03V$

(2) $Zn \rightarrow Zn^{2+} + 2e^- \qquad E^0 = 0.763V$

on reversing 2nd reaction and adding it to reaction 1

Anode $Zn + 4NH_3 \rightarrow Zn\left(NH_3\right)_4^{2+} + 2e^-$

Cathode $Zn^{2+} + 2e^- \rightarrow Zn$

$$Zn^{2+} + 4NH_3 \rightarrow Zn\left(NH_3\right)_4^{2+}$$

Equilibrium constant of above cell reaction is formation constant

$$E^0_{cell} = E^{0\ \text{cathode}}_{red} - E^{0\ \text{anode}}_{red}$$

But values in equation given are of oxidation potential

so $E^{0\ \text{cathode}}_{red} = -0.763$

$E^{0\ \text{anode}}_{red} = -1.03$

$E^0_{cell} = -0.763 + 1.03$

$E^0_{cell} = 0.267$

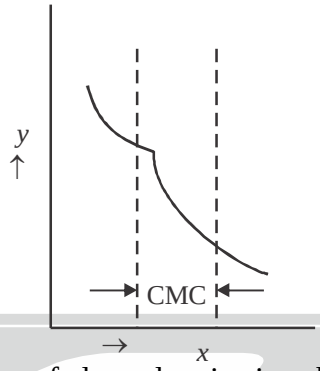
Now, $E^0_{cell} = \frac{0.0591}{n}\log K_{eq}$

$$0.267 = \frac{0.0591}{2}\log K_{eq} \quad \Rightarrow \quad \frac{0.267\times 2}{0.0591} = \log K_{eq} \quad \Rightarrow \quad 9.03 = \log K_{eq}$$

$K_{eq} = 10^{9.03} \quad \Rightarrow\ K_{eq} \simeq 10^9$

Correct option is (c)

142. The molar conductance of anionic surfactant of the type Na^+R^- (sodium dodecylsulfate in water) in water is plotted against the square root ofthe normality of the solution. The curve obtained, instead of being the smoothly decreasing curve characteristic of ionic electrolytes of this type, has a shart break in it, at low concentrations. This sharp break in the curve accompanied by reduction in the conductance of the solution, indicating a sharp increase in the mass per unit charge of the material in solution, is interpreted as evidence for the formation of micelles at that point from the unassociated molecules of surfactant with part of the charge of the micelle neutralized by associated counter ions. The concentration at which this phenomenon occurs is called the critical micelle concentration (CMC)



The effect of concentration of electrolyte is given by

$$\boxed{\log \text{CMC} = -a \log c_i + b}$$

For homologous ionic surfactant

$$\boxed{\log \text{CMC} = A - BN}$$

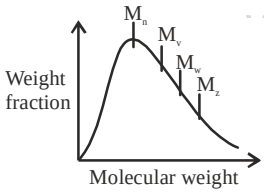
Correct answer is (d)

143. $\sin^2\theta$ at $2x$, $4x$, $6x$, $8x$

$\Rightarrow$ B.C.C

$$\Rightarrow x = \frac{\lambda^2}{4a^2} \Rightarrow a = \frac{7}{2\sqrt{x}} = \frac{1.54}{2\times\sqrt{0.06}} = 3.14\text{Å}$$

Correct option is (a)

144. 

Correct order is $M_n < M_v < M_w < M_z$.

Correct option is (b)

145. $T_1 = \frac{1}{2}V_1 \Rightarrow T_2 = -\frac{1}{2}V_2$

$E_1 < E_2$

$$T_1 + V_1 < T_2 + V_2 \Rightarrow \frac{V_1}{2} < \frac{V_2}{2} \Rightarrow V_1 < V_2 \text{ and } T_1 > T_2$$

Correct option is (c)