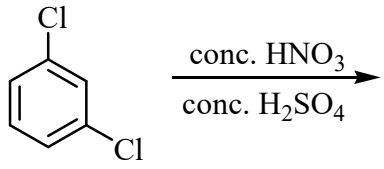
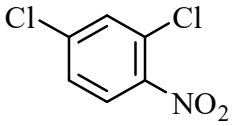
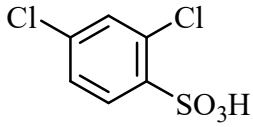
CSIR NET (2021)

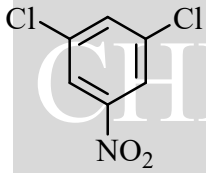
Section - A

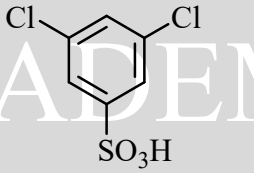
21. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(c) 

22. Of the following statements regarding dissociative substitution in an octahedral transition metal complex,

(A) High steric hindrance between ligands in the metal complex favors fast dissociation of ligand.

(B) Increased charge on the metal atom/ion of the complex favours the acceptance of electron pair of the entering ligands.

(C) A pentacoordinated intermediate is observed.

(D) Nature of the entering ligand significantly influences the reaction.

(a) A and D (b) A and C (c) A, C and D (d) A, B, C and D

23. The correct order of the electron affinity for one-electron gain of the elements is

(a) F > Cl > Br (b) P > N > As (c) S > Se > O (d) K > Li > Na

24. The effective magnetic moment (in BM) for a lanthanide f^0 ion is approximately

(a) 10.6 (b) 9.92 (c) 9.59 (d) 7.94

25. Consider an octahedral complex Ma_2b_2cd, where a, b, c, and d are monodentate ligands. The number of enantiomeric pairs for the complex is

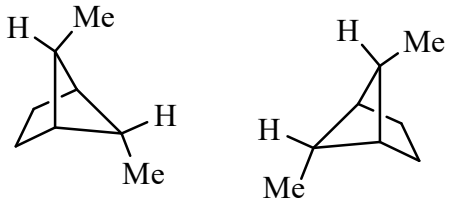
(a) One (b) two (c) three (d) four

26. The reactive cross section is expected to be the largest for the reaction

(a) $Li + Cl_2 \rightarrow LiCl + Cl$ (b) $Na + Cl_2$

(c) $K + Cl_2$ (d) $Rb + Cl_2$

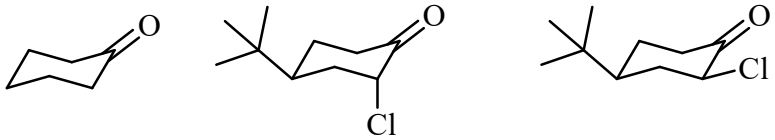
27. The correct relationship between the following structures is that they are



(a) identical (b) enantiomers

(c) diastereomers (d) constitutional isomers

28. The correct order of C = O stretching frequency in IR spectrum for the following compounds is:



A B C

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

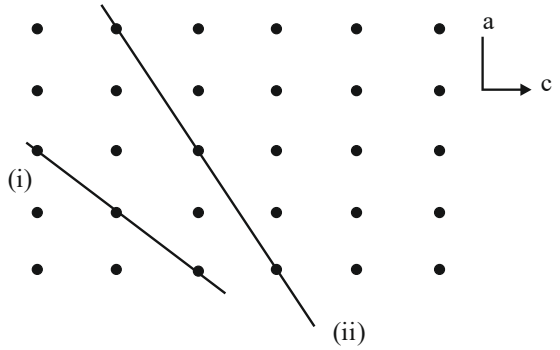
29. Match the items of column I with the application given in column II

Column I		Column II	
a	Zeolite	i.	Solar cell
b	Indium tin oxide	ii.	CO_2 capture
c.	$LiCoO_2$	iii.	Fuel cell
d.	Pt alloy	iv.	Battery

(a) a–iii; b–iv; c–i; d–ii, (b) a–i; b–iii; c–ii; d–iv

(c) a–ii; b–i; c–iv; d–iii (d) a–iv; b–ii; c–iii; d–i

30. The miller indices of the planes parallel to the b axis and intersecting the a and c axis, as shwon in the figure are

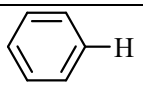
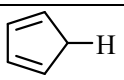


(a) 101, (ii) 102 (b) (i) 102, (ii) 101 (c) (i) 100, (ii) 101 (d) (i) 100, (ii) 102

31. For $[Hg_2]^{2+}$, the bond order and the orbitals involved in bonding are, respectively

(a) one; s and s (b) two; s and p (c) one; p and p (d) three; s and d

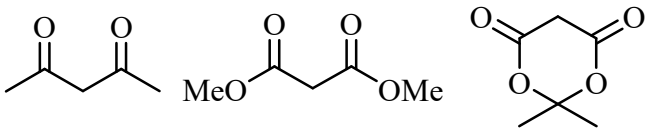
32. The correct match for the bond dissociation Energies (BDE) of the C–H bonds compounds in Column I, with the values in Column II is (As an example, the BDE for Me-H is 105.0 kcal/mol)

	Column		Column II BDE (kcal/mol)
a.		i.	110.9
b.		ii.	71.1
c.		iii.	132.0
d.	$CH \equiv C-H$	iv.	90.6

(a) a – iii; b – iv; c – i; d – ii (b) a – i; b – iii; c – ii; d – iv

(c) a – iii; b – i; c – iv; d – ii (d) a – iv; b – i; c – ii; d – iii

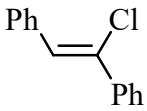
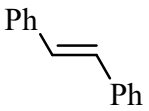
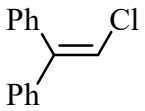
33. The pKa valuies for the following compounds



A B C

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

34. The major product formed in the following reaction

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

35. The number of micro states corresponding to the atomic term symbol ^4F is

(a) 7 (b) 12 (c) 28 (d) 42

36. The ozonolysis of a hydrocarbon in the presence of water produced pentanoic acid and carbonic acid. The hydrocarbon is

(a) 1-hexene (b) 1-hexyne (c) 5-decene (d) 5-decyne

37. Among the following which set of molecular/ionic species all have a planar structure?

(a) BrF_3, $FClO_2$ and $[XeF_5]^-$ (b) XeO_3, $[ClF_4]^-$ and $FClO_2$

(c) $[ClF_4]^-$, BrF_3 and $[XeF_5]$ (d) $FClO_2$,$[XeF_5]^-$ and XeO_3

38. The volume of nitrogen gas adsorbed at STP to form a monolayer on a porous solid surface is 22.4 cm^3 g^{-1}. If the area occupied by one nitrogen gas molecule is 16.2 $Å^2$, then the surface area (in cm^2 g^{-1}) of the solid is close to:

(a) 1.2×10^7 (b) 9.8×10^5 (c) 1.2×10^5 (d) 9.8×10^8

39. The penetrating power (R) and ionizing power (I) of α, β, and γ rays follow the ordering

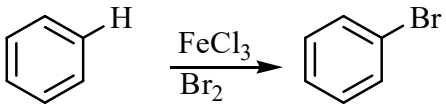
(a) $R_\beta > R_\gamma > R_\alpha$ and $I_\beta > I_\gamma > I_\alpha$ (b) $R_\gamma > R_\beta > R_\alpha$ and $I_\beta > I_\gamma > I_\alpha$

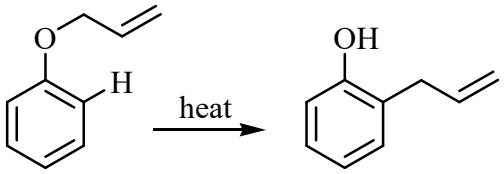
(c) $R_\beta > R_\alpha > R_\gamma$ and $I_\beta > I_\gamma > I_\alpha$ (d) $R_\gamma > R_\beta > R_\alpha$ and $I_\alpha > I_\beta > I_\gamma$

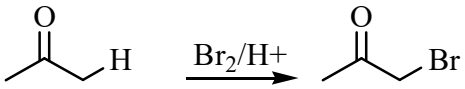
40. The amount of $Ba(NO_3)_2$ (molecular weight 261.32 amu) required to be added to 500 g of a 0.11 mol kg^{-1} solution of KNO_3 in order to raise its ionic strength to 1.00 is approximately:

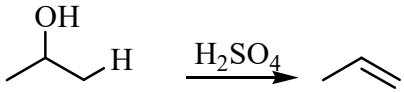
(a) 38.8 g (b) 19.4g (c) 76.2 g (d) 126.5 g

41. The reaction that is expected to show a primary kinetic isotope effect for the indicated H-atom (C–H) is

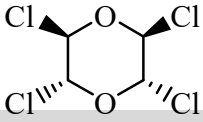
(a) 

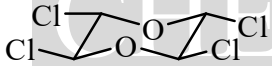
(b) 

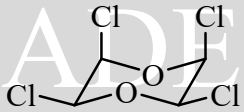
(c) 

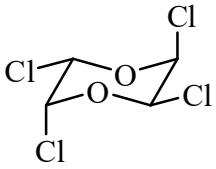
(d) 

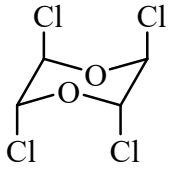
42. The structure that corresponds to the most stable conformation of the following compound is



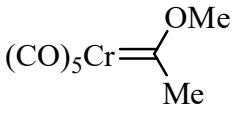
(a) 

(b) 

(c) 

(d) 

43. Consider the following statement(s) in the context of organometallic complex (X):



A. The carbene ligand donates two electrons to the metal and accepts d electrons to make a π-bond

B. The C (carbene) is nucleophilic

C. Rotation around the Cr = C(OMe)Me double bond haslow barrier (< 10 kcal/mol)

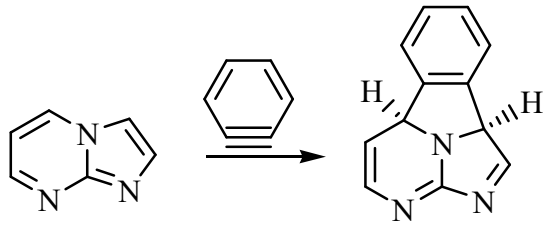
Correct statement(s) is/are:

(a) A and B (b) A only (c) A and C only (d) B and C

44. The rate of decomposition of a gas is 10 mM s^{-1} when 10 % is reacted and it is 5 mM s^{-1} when 40 % is reacted. The order of the reaction is:

(a) 2 (b) 1.71 (c) 0 (d) 2.15

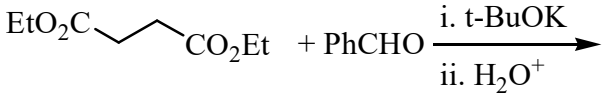
45. The following transformation

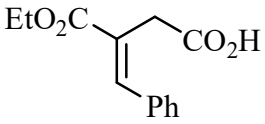


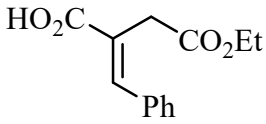
(a) [3π + 2π] cycloaddition (b) [6π + 2π] cycloaddition

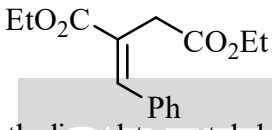
(c) [8π + 2π] cycloaddition (d) [8π + 4π] cycloaddition

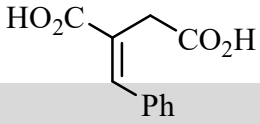
46. The major product formed in the following reaction



(a) 

(b) 

(c) 

(d) 

47. For the ligand-to-metal charge-transfer (LMCT) transitions in the oxo-anions given below, the wavelength of the transitions are in the order

(a) $VO_4^{3-} < CrO_4^{2-} < MnO_4^{-}$ and $WO_4^{2-} < MoO_4^{2-} < CrO_4^{2-}$

(b) $VO_4^{3-} < CrO_4^{2-} < MnO_4^{-}$ and $WO_4^{2-} > MoO_4^{2-} > CrO_4^{2-}$

(c) $VO_4^{3-} > CrO_4^{2-} > MnO_4^{-}$ and $WO_4^{2-} < MoO_4^{2-} < CrO_4^{2-}$

(d) $VO_4^{3-} > CrO_4^{2-} > MnO_4^{-}$ and $WO_4^{2-} > MoO_4^{2-} > CrO_4^{2-}$

48. When yellow phosphorous is converted to red phosphorous, the entropy and volume of the system do not change. The order of this phase transition is most likely to be

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

49. Consider following statement(s) in the context of NO and CO ligands

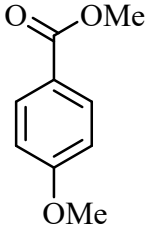
A. In the bent mode, NO donates three electrons to the metal center.

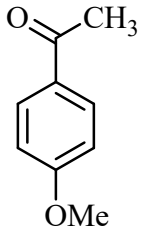
B. In IR spectrum, the ν_{NO} for the bent nitrosyl ligand typically lies between 1525 and 1690 cm^{-1}.

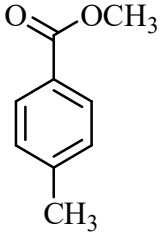
C. The HOMO of NO and Co are Π* and σ orbitals, respectively.

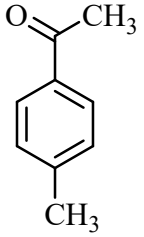
(a) A only (b) B and C (c) A and C (d) A and B

50. Which of the following compound has the ^1H NMR Spectrum ^1H NMR: δ 2.4 (s, 3H), 3.9 (s, 3H), 7.25 (d, J = 7 Hz, 2H), 7.95 (d, J = 7 Hz, 2H) ppm

(a) 

(b) 

(c) 

(d) 

51. The hypothetical NMR spectrum of ^1H in $^1H - C - ^2H$ would consist of (spin of the ^2H is 1) a

(a) Singlet (b) Doublet of 1:1 ratio

(c) Triplet of 1:1:1 ratio (d) Triplet of 1:2:1 ratio

52. The total number of lone pairs of electrons on all the atoms in cyanogen azide and thiocyanogen respectively, are

(a) 4 and 6 (b) 6 and 6 (c) 3 and 4 (d) 4 and 4

53. The total π-electron density on the four carbon atoms of trans butadiene are in the ratio

(a) 1 : 1 : 1 : 1 (b) 1 : 2 : 2 : 1 (c) $1:\sqrt{2}:\sqrt{2}:1$ (d) 1 : 3 : 3 : 1

54. The commutator, $\left[\hat{x}, \hat{p}_x^2\right]$ is equivalent to

(a) $-2i\hbar\hat{p}_x$ (b) $2i\hbar\hat{p}_x$ (c) $-i\hbar\hat{p}_x$ (c) $i\hbar\hat{p}_x$

55. When three of the phases of a two component system are simultaneously in equilibrium the number of degrees of freedom is

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

56. Identify the correct statement for the two reaction given below

$$Xe + PtF_6 \xrightarrow{SF_6} [Xe]^+ (PtF_6]^-$$

$$XeF_4 + Me_4NF \rightarrow [Me_4N]^+ [XeF_5]^-$$

(a) Xe and XeF_4 both act as acids (b) Xe and XeF_4 both act as bases.

(c) Xe acts as an acid and XeF_4 acts as base. (d) Xe acts as base and XeF_4 acts as an acid.

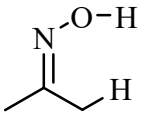
57. The combination of two reflections, $\sigma_v'\sigma_v''$ about an intersecting mirror place is equivalent to

(a) S_n (b) C_n (c) σ_h (d) i

58. For a person weighing 70 kg the minimal volume (in mL) of a fatal dose of a compound with $LD_{50} = 80$ $mg.kg^{-1}$, and density = 1.45 $g.mL^{-1}$ is

(a) 5.6 (b) 3.9 (c) 0.8 (d) 0.4

59. The molecular orbital involved int he interaction of the oxime shown below, with a base is



(a) σ^* of O – H (b) σ^* of C – H (c) σ of O – H (d) σ of C – H

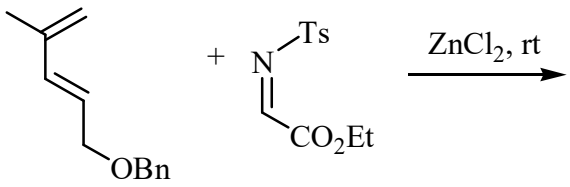
60. For a micro-canonical system, the correct probability distribution function for energy is given by

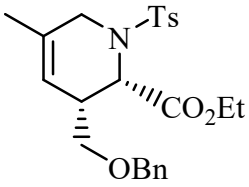
(a) Exponential distribution function (b) Gaussian distribution function

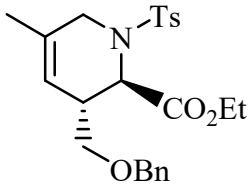
(c) Poisson distribution function (d) Uniform distribution function

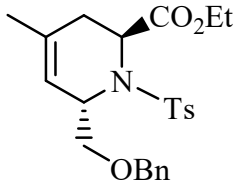
Section - B

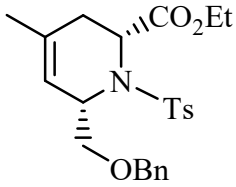
61. The major product formed in the following reaction is



(a) 

(b) 

(d) 

(d) 

62. When a hydrogen atom is exposed to a perturbation V = E.z, the first order correction to the wave function comes only from the orbital

(a) 2s (b) $2p_z$ (c) $3p_y$ (d) $3d_z^2$

63. The rate constant for the reaction, $A_2B_4O + AO$, is described as,

$$\log k = 14.1 - \frac{1000K}{T}$$

The activation energy for this reaction (in kJ mol^{-1}) is closest to

(a) 191.4 (b) 83.14 (c) 382.8 (d) 166.28

64. A compound shows [M]+ at m/z 84 and has a base peak at 56. It exhibits only one signal in ^1H NMR at δ 1.4 ppm and one signal in ^{13}C NMR at δ 35 ppm. The compound is

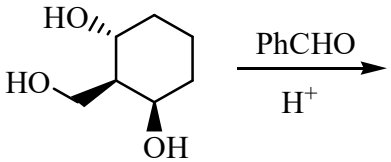
(a) cyclobutane-1,3-dione (b) dichloromethane

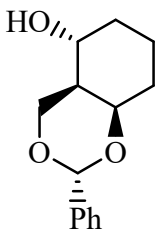
(c) cyclohexane (d) 1,2,3-trimethylcyclopropane

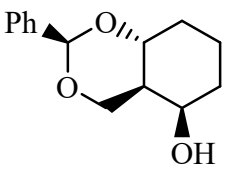
65. A sample of polystyrene is composed of three weight fractions: 0.20, 0.50 and 0.30. The molecular weight of these fractions are 10,000 , 40,000 and 60,000, respectively. The weight average molecular weight of this sample is:

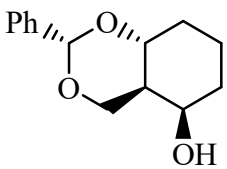
(a) 40000 (b) 55000 (c) 50000 (d) 60000

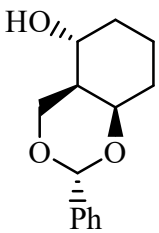
66. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

67. The molecule that will not absorb in the microwave region, but will absorb in the infrared is

(a) N_2 (b) C_2H_2 (c) HCl (d) H_2O

68. The number of CO bands for isomers from sets (i) and (ii) in their IR spectra

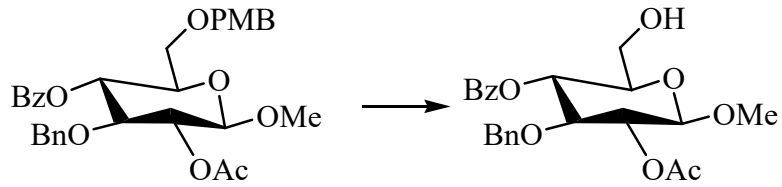
Set (i): Trigonal bipyramidal isomers, axial-$Fe(CO)_4L$ (A) and equatorial-$Fe(CO)_4L$ (B)

Set (ii): Octahedral isomers, fac-$Mo(CO)_3L_3$ (C) and mer-$Mo(CO)_3L_3$(D) are

(a) A, 4 and B, 3; C, 3 and D, 2 (b) A, 4 and B, 3; C, 2 and D, 3

(c) A, 3 and B, 4; C, 3 and D, 2 (d) A, 3 and B, 4; C, 2 and D, 3

69. The reagent that will effect the following selective conversion is



(a) NaOMe, MeOH (b) TBAF, THF

(c) DDQ, CH_2Cl_2 (d) $Et_{2_{N,\ MeOH}}$

70. For the reaction

$$[Cis-M(en)_2(OH)_2]^+ \underset{k_2}{\overset{k_1}{\rightleftharpoons}} [trans-M(en)_2(OH)_2]^+$$

the equilibrium constant is 0.6 and k_1 is $3.3 \times 10^{-4} s^{-1}$. The experiment is started with pure cis form. The time taken for half the equilibrium amount of trans isomer to be formed is about

(a) 290s (b) 580s (c) 190s (d) 480s

71. Consider following terms. Identify those which are relevant to d.c. polarography

A. Thermal current B. Supporting electrolyte

C. Depolarization D. Gelatin

Correct answer is

(a) A, B, and C (b) A, B and D (c) B, C and D (d) C and D only

72. The ore (X) gives a d-block metal (M) in the elemental form, following a chemical process. Which of the sets X/ M/Chemical process below is correct?

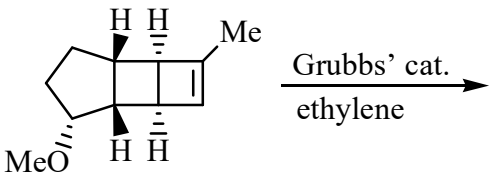
(a) Ilmenite/ Titanium/ $2FeTiO_3 + Mg + O_2 \rightarrow 2TiO_2 + MgO + Fe_2O_3$ followed by reduction of TiO_2 with Mg.

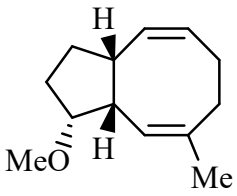
(b) Rutile/ Titanium/$TiO_2 + 2C + 2Cl_2 \rightarrow TiCl_4 + 2CO$ followed by reduction of $TiCl_4$ with Na or Mg.

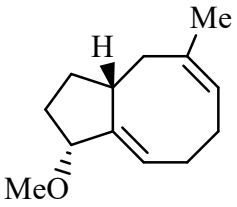
(c) Rutile/ Titanium/ $TiO_2 + 4HCl$ (conc.) $\rightarrow TiCl_4 + 2H_2O$ followed by electrolytic reduction of $TiCl_4$

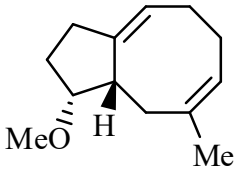
(d) Molybdenite/ Molybdenum $2MoS_2 + 7O_2 \rightarrow 2MoO_3 + 4SO_2$ followed by reduction of MoO_3 with carbon

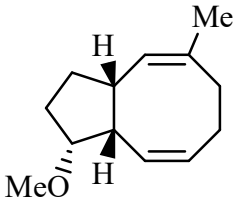
73. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

74. The surface tension of a dilute soap solution is lower than that of pure water because

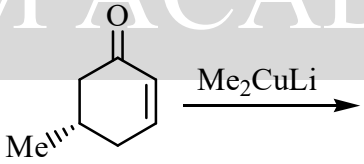
(a) soap molecules accumulate more at the surface than in the bulk solution

(b) soap molecules accumulate more in the bulk of the solution than on the surface

(c) the soap molecules aggregate uniformly in the bulk and the surface.

(d) soap molecules form micellar structures at low concentration.

75. The major product formed in the following reaction is



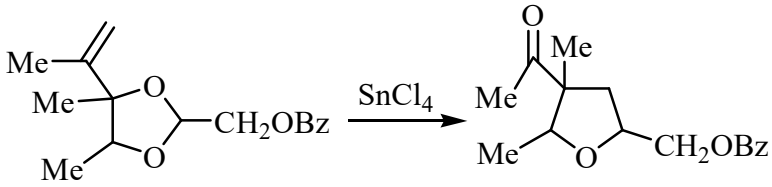
(a) cis-3,5-dimethylcyclohexanone, which is chiral

(b) trans-3,5-dimethylcyclohexanone, which is chiral

(c) cis-3,5-dimethylcyclohexanone, which is achiral

(d) trans-3,5-dimethylcyclohexanone, which is achiral

76. The correct sequence of mechanistic steps involved in the formation of product in the following reaction is



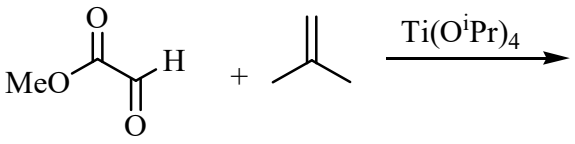
(a) Prins cyclization, formation of oxonium ion, pinacol rearrangement

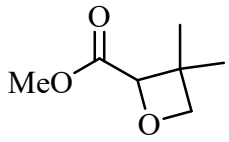
(b) pinacol rearrangement, Prins cyclization and formation of oxonium ion

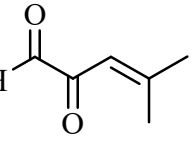
(c) formation of oxonium ion, Prins cyclization and pinacol rearrangement

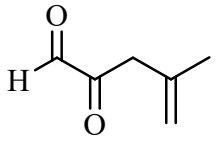
(d) pinacol rearrangement, formation of oxonium ion and Prins cyclization

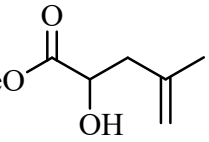
77. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

78. A system consists of N identical distinguishable non-interacting particles, each having only two energy levels 0 and $\in$. The expression of the heat capacity at constant volume (C_v) is given by ($\beta = 1/k_BT$)

(a) Nk_B (b) $Nk_B\left(\frac{\in\beta}{1+e^{\in\beta}}\right)^2$ (c) $Nk_B\left(\frac{\in\beta e^{\in\beta/2}}{1+e^{\in\beta}}\right)^2$ (d) $Nk_B\left(\frac{\in\beta e^{-2\in\beta}}{1+e^{-\in\beta}}\right)^2$

79. The following data is obtained for a light diatomic (AB) molecule from its rotational Raman spectrum.

$B = 2cm^{-1}$; $x_e = 0.01$; $\overline{\nu_e} = 1600\ cm^{-1}$.

If the molecule is irradiated by a laser of 20,000 cm^{-1}, the expected stokes lines (in cm^{-1}) for this molecule are

(a) 18348, 18356, 18368, 18380, 18388 (b) 18412, 18420, 18432, 18444, 18452

(c) 18380, 18388, 18400, 18412, 18420 (d) 18416, 18424, 18430, 18440, 18452

80. In 3-iron ferredoxins, the number of sulfide bridges and cysteinyl ligands, respectively, are:

(a) 3, 3 (b) 4, 3 (c) 3, 4 (d) 4, 4

81. The correct statements from the following set (i) to (iv) is

(i) If q is the displacement from equilibrium for harmonic motion, the potential energy is proportional to q.

(ii) If the vibrational frequency $(\overline{\nu})$ of HCl is 2990 cm^{-1}, its zero point energy will be 1495 cm^{-1}.

(iii) The correct order of vibrational frequency of O–^{1}H (X_1), O–^{2}H (X_2), and O–^{3}H (X_3), is $X_1 > X_2 > X_3$.

(iv) The fundamental vibrational transition of a diatomic molecule appears at 1880 cm^{-1}. Its first overtone will be at 940 cm^{-1}.

(assuming anharmonicity constant as zero).

(a) i, ii, iii only (b) i, ii, iii, iv (c) ii, iii only (d) i, ii, iv only

82. Which of the following reaction(s) do(es) NOT occur

(i) $\left[NPCl_2\right]_3 + 6\,NaF \xrightarrow[\text{reflux}]{MeCN} \left[NPF_2\right]_3 + 6\,NaCl$

(ii) $n\,PCl_5 + n\,NH_4Cl \xrightarrow[\text{reflux}]{C_6H_5Cl} \left[NPCl_2\right]_n + 4n\,HCl \left[n = 3,4,5...\right]$

(iii) $n\,PF_5 + n\,NH_4F \xrightarrow[\text{reflux}]{C_6H_5Cl} \left[NPF_2\right]_n + 4n\,HF \left[n = 3,4,5...\right]$

(a) (i) and (iii) (b) (i) and (ii) (c) (i) only (d) (iii) only

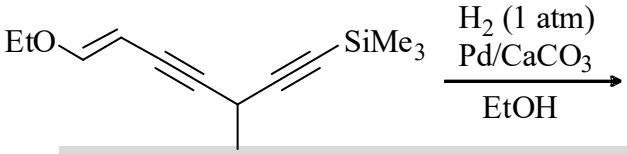
83. The type of molecular orbitals in the allyl ligand ($CH_2 = CH - CH_2^-$) that are used for σ-donation and π-back donation with metal d-orbitals, respectively are

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

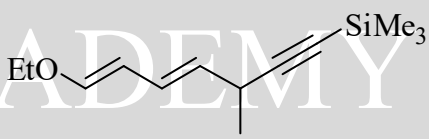
84. The quantum number corresponding to the z-component of the total electronic orbital angular momentum in the nitric oxide molecule is

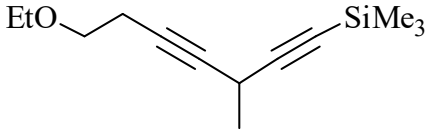
(a) 0 (b) 1 (c) 2 (d) 3

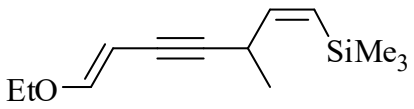
85. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

86. For trigonal bipyramidal coordination complex (ML_5) the correct point group symmetry and the relative order of the energies of the 3d orbitals in that crystal field, respectively are

(a) $D_{3h}; d_{x^2-y^2} > d_{z^2}, d_{xy} > d_{xz}, d_{yz}$ (b) $D_{3d}; d_{z^2} > d_{x^2-y^2}, d_{xz} > d_{xy}, d_{yz}$

(c) $D_{3d}; d_{x^2-y^2} > d_{z^2} > d_{xy} > d_{xz}, d_{yz}$ (d) $D_{3h}; d_{z^2} > d_{x^2-y^2}, d_{xy} > d_{xz}, d_{yz}$

87. Liquid A has half the surface tension and twice the density of liquid B at 30 °C. The contact angles of A and B are the same. If A rises 10 cm in a capillary then the rise (in cm) of liquid B in the same capillary at the same temperature will be equal to

(a) 60 (b) 10 (c) 40 (d) 20

88. Consider following statements

A. $PbCl_2$ has low solubility in water.

B. Sulfides of As(III) and Sb(III) are soluble in ammonium sulfide.

C. SnS is soluble in yellow ammonium sulfide.

D. MnS is precipitated by passing H_2S through acidic $MnCl_2$.

Correct statements are

(a) A, B and C (b) B, C and D (c) A, C and D (d) A and C

89. The equivalent symmetry operations for S_6^3 and S_3^6 are, respectively

(a) C_3 and C_2 (b) σ_h and i (c) σ_h and E (d) i and E

90. Which of the following statements for rubredoxin,

A. Fe^{2+} center has a tetrahedral geometry.

B. Reduced form of iron is diamagnetic.

C. Fe^{2+} center undergoes Jahn-Teller distortion.

D. It is a [2Fe – 2S] cluster.

are correct?

(a) A, B and C (b) A, C and D (c) C and D (d) A and C

91. Choose the correct statement(s) from the following:

(i) The trend in Lewis acidity among silicon halides is $SiI_4 < SiBr_4 < SiCl_4 < SiF_4$.

(ii) Tin(II) chloride can act as a Lewis acid and not as a Lewis base.

(iii) Aluminosilicates can display Brønsted acidity.

(a) (i) and (ii) (b) (i) and (iii) (c) (ii) and (iii) (d) (ii) only

92. The correct geometries for the metal carbonyl clusters, A-C

(A) $[Ru_6(CO)_{17}B]^-$ (B) $[Os_6(CO)_{18}P]^-$ (C) $[Os_4(CO)_{16}]$

(a) A: pentagonal bipyramidal, B : trigonal prismatic and C : tetrahedral

(b) A : pentagonal bipyramidal, B : octahedral and C : square

(c) A : octahedral, B : trigonal prismatic and C : tetrahedral

(d) A : octahedral, B : trigonal prismatic and C : square

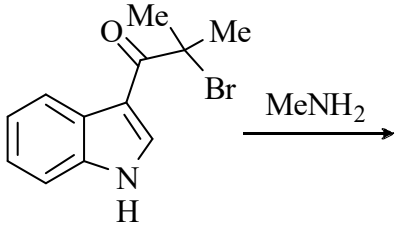
93. For every atom that is not shifted under C_4 and σ symmetry operations, the characters are, respectively

(a) –1, –1 (b) 0, 0 (c) 1, 1 (d) –1, 1

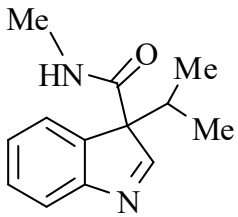
94. In a Langmuir-type adsorption, a solid adsorbs 0.25 mg of a gas when the pressure of the gas is 50 bar and 0.2 mg of the gas at 20 bar pressure. The percentage of surface coverage at 50 bar is close to:

(a) 75 (b) 38 (c) 57 (d) 83

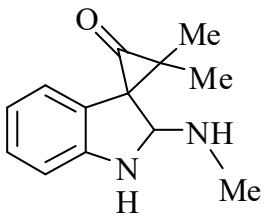
95. The major product formed in the following reaction is:

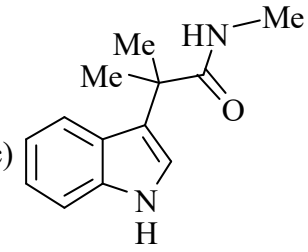


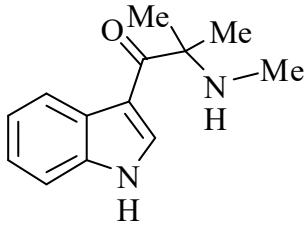
(a)



(b)



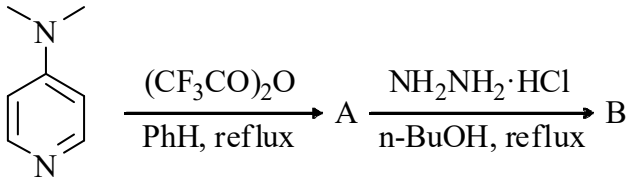
(c) 

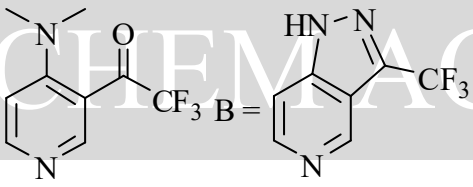
(d) 

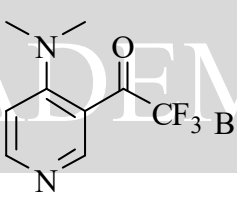
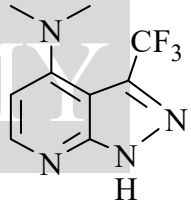
96. Plutonium (atomic mass = 244 g mol^{-1}) crystallizes in monoclinic lattice (a = 620 pm; b = 480 pm; c = 1100 pm; b =120°) with 16 atoms per unti cell. The density in g cm^{-3} will be close to (Use sin β = 0.98; sin β / 2 = 0.78)

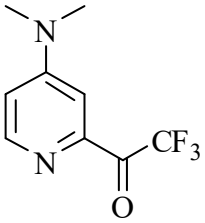
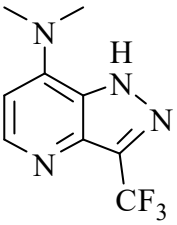
(a) 25.38 (b) 16.12 (c) 12.69 (d) 20.26

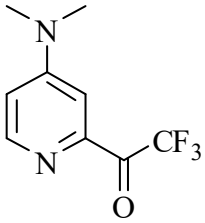
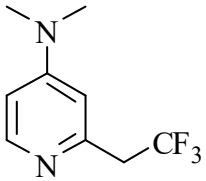
97. The major product A and B in the following reaction sequence are



(a) A =  B =

(b) A =  B = 

(c) A =  B = 

(d) A =  B = 

98. The absorption spectrum of $[Cr(NH_3)_6]^{3+}$ in water shows two bands around 475 and 365 nm. The ground term and the spin-allowed transitions, respectively, are

(a) ^4F; $^4T_{1g}(F) \rightarrow {}^4T_{2g}$ and $^4T_{1g} \rightarrow {}^4A_{2g}$ (b) ^4F; $^4A_{2g} \rightarrow {}^4T_{2g}$ and $^4A_{2g} \rightarrow {}^4T_{1g}(F)$

(c) ^2G; $^2E_g \rightarrow {}^2T_{1g}$ and $^2E_g \rightarrow {}^2T_{2g}$ (d) ^2F ; $^2A_{2g} \rightarrow {}^2T_{2g}$ and $^2A_{2g} \rightarrow {}^2T_{1g}(F)$

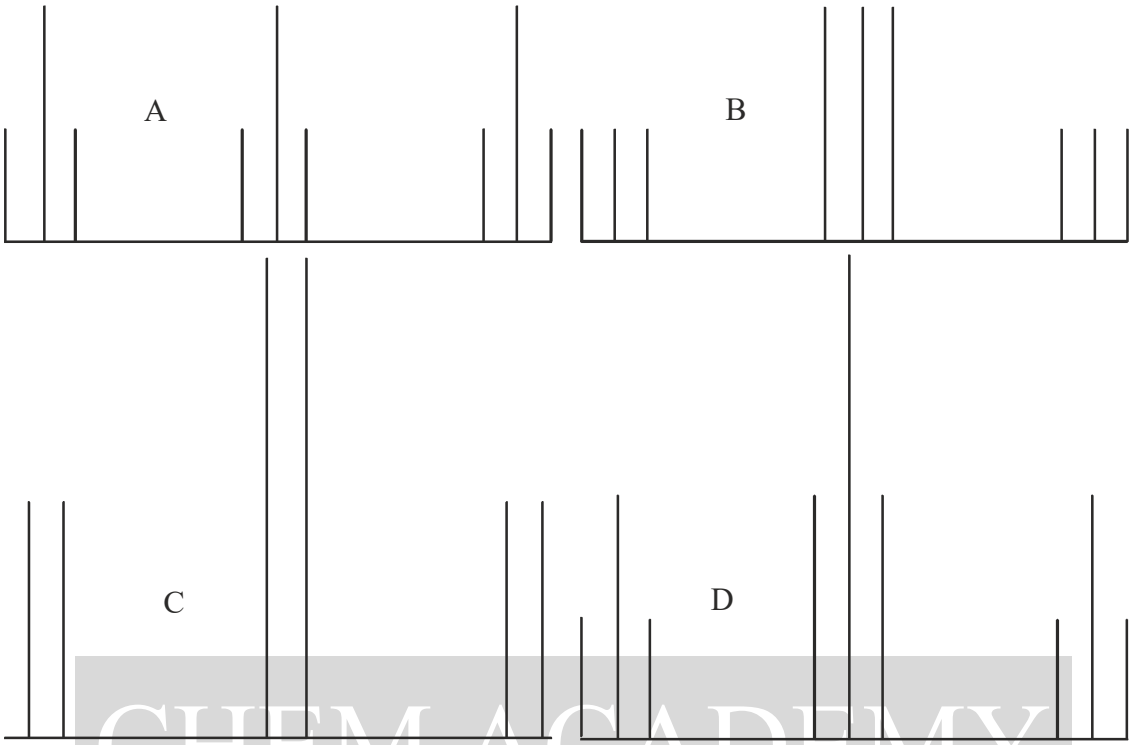
99. Match the iron and copper proteins with biological function in the table below:

Iron protein		Copper protein		Biological function	
A	Hemerythrin	i	Azurin	X	Oxygenase
B	Cytochrome P 450	ii	Hemocyanin	Y	Electron transfer
C	Rieske protein	iii	Tyrosinase	Z	O_2 transport

(a) A-ii-Z, B-iii-X, C-i-Y (b) A-ii-Z, B-i-X, C-iii-Y

(c) A-iii-Y, B-i-Z, C-ii-X (d) A-i-Y, B-iii-Z, C-ii-X

100. Which of the patterns (A, B, C or D) fits best with the ^{13}C NMR spectrum of $TiCl_3(CDH_2)$ [Given: ^{1}.J(C-H) > ^{1}J(C-D)]

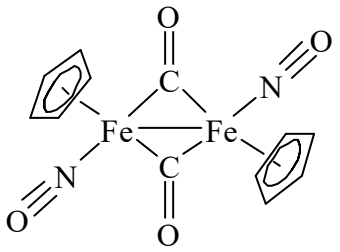


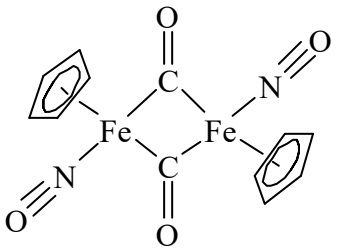
(a) A (b) B (c) C (d) D

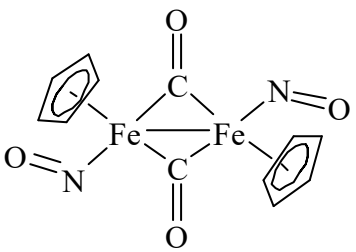
101. For a weak electrolyte such as acetic acid, the relation among conductance (λ), equilibrium constant (I) and concentration (C) can be expressed as: (λ^0 is the conductance at infinite dilution)

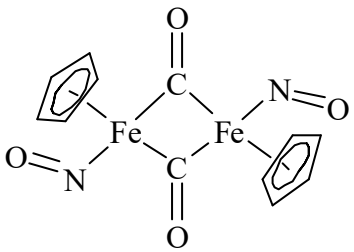
(a) $\frac{1}{\lambda}=\frac{1}{\lambda^0}-\frac{C\lambda}{K\lambda^0}$ (b) $\frac{1}{\lambda}=\frac{1}{\lambda^0}+\frac{C\lambda}{K\lambda^{0^2}}$ (c) $\frac{1}{\lambda^0}=\frac{1}{\lambda}+\frac{C\lambda}{K\lambda^{0^2}}$ (d) $\frac{1}{\lambda}=\frac{C\lambda}{K\lambda^{0^2}}$

102. Identify the thermodynamically stable structure of $[(\eta^5-C_5H_5)Fe(\mu_2-CO)(NO)]_2$

(a) 

(b) 

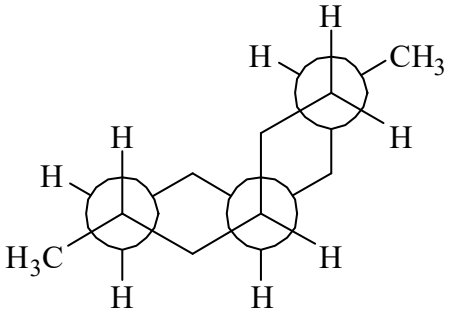
(c) 

(d) 

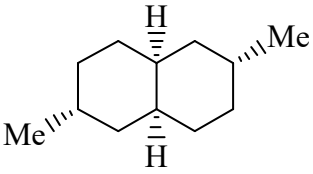
103. The maximum number of phases that can be simultaneously in equilibrium for a one component system is

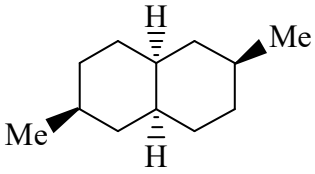
(a) 1 (b) 2 (c) 3 (d) 4

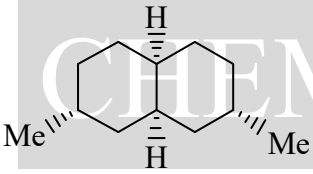
104. The Newman projection given below

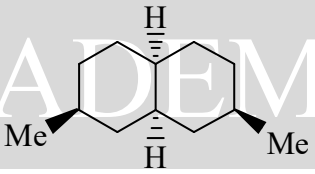


Corresponds to the compound

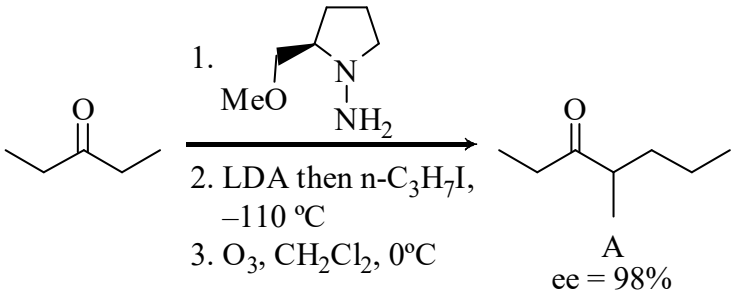
(a) 

(b) 

(c) 

(d) 

105. Given the specific rotation $[\alpha]_D^{20}$ of (S)-4-methyl-3-heptanone in hexane as +22°, the specific rotation $[\alpha]_D^{20}$, in hexane, of the product A (ee = 98%) obtained from the following enantioselective alkylation reaction is



(a) +21. 56 (b) +21. 12 (c) –21.56 (d) –21.12

106. Consider an electron ($m_e = 9.1 \times 10^{-31}$ kg) having energy 13.6 eV, confined in an infinite potential well. If the potential energy inside the well is zero, the expectation value for the square of the electron speed $\langle v^2 \rangle$, is

(a) 3×10^{12} m^2 s^{-2} (b) 4.3×10^{-18} m^2 s^{-2}

(c) 4.7×10^{12} m^2 s^{-2} (d) 4.7×10^{31} m^2 s^{-2}

107. Consider the following statements for the self-exchange electron transfer reaction in $[Cr(H_2O)_6]^{2+/3+}$

(A) σ^* orbitals are only involved in electron transfer

(B) It involves large inner-sphere reorganization energy

(C) It involves no change in M–L bond lengths

(D) Rate of self-exchange electron transfer is fast

The correct statements are

(a) A, B and D (b) A and B (c) A and C (d) B and D

108. For the cell Cd | $CdCl_2$ || AgCl | Ag ; $E^o_{cell} = 0.675$ V and $dE^o_{cell} / dT = -6.5 \times 10^{-4}$ V K^{-1} at 27°C. The ΔH (kJ mol^{-1}) value for the reaction $Cd + 2AgCl \rightarrow 2Ag + CdCl_2$ is closest to:

(a) – 168 (b) – 123 (c) – 95 (d) – 234

109. The stopping potential for photoelectrons emitted from a surface illuminated by light of frequency 6.0×10^8 MHZ is 0.72 V. When the incident frequency is changed, the stopping potential is found to be 1.44 V. The new frequency is approximately ($e/h = 2.4 \times 10^{14}$ C J^{-1} s^{-1})

(a) 7×10^8 (b) 4×10^8 (c) 2×10^9 (d) 7×10^{14}

110. Which of the statements (A-D) given below are correct for B_2H_6 molecule:

A. Addition of $Et_2O \cdot BF_3$ to $NaBH_4$ in a polyether solvent produces B_2H_6.

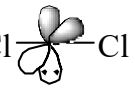
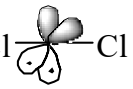
B. It has D_{2d} symmetry.

C. Reaction of B_2H_6 with NMe_3 gives $Me_3N \cdot BH_3$.

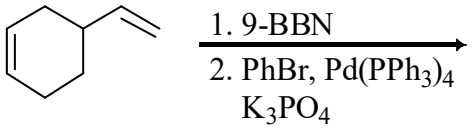
D. It is diamagnetic.

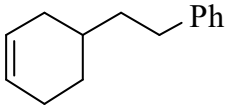
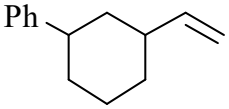
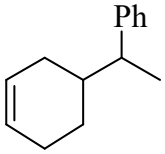
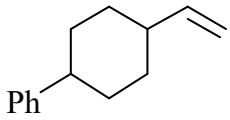
(a) A, B and C (b) A, C, D (c) A and B (d) B and D

111. The structure of the reactive intermediate generated by reaction of $CHCl_3$ and KOH is

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

112. The major product formed in the following reaction is



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

113. Consider the following statements regarding EPR spectra:

(A) For allowed transitions, $\Delta Ms = \pm 1$ and $\Delta M_I = 0$

(B) For allowed transitions, $\Delta Ms = 0$ and $\Delta M_I = \pm 1$

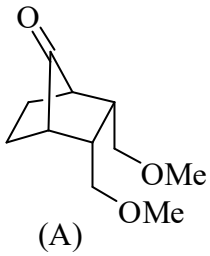
(C) Tetragonally elongated Cu(II) complexes have $g_{II} > T_{\perp}$.

(D) The orbital considered as ground state for tetragonally compresssed Cu(II), complexes, $d_{x^2-y^2}$.

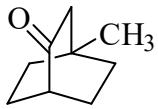
The correct statement are

(a) (A), (C) and (D) (b) (B), (C) and (D) (c) (A) and (C) only (d) (B) and (D) only

114. The correct relationship between the two faces of the C = O group in compounds A and B is



(A)

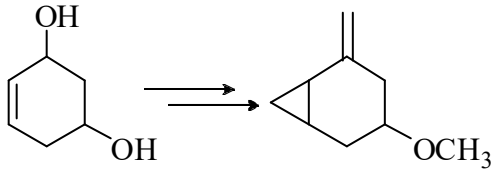


(B)

(a) A =diastereotopic; B =enantiotopic (b) A = B =enantiotopic

(c) A = enantiotopic; B =diastereotopic (d) A = B =diastereotopic

115. The correct sequence of reagents that will lead to the formation of the given product in the following transformation is



(a) I. active MnO_2; II. MeI, NaH; III. $Me_3S(O)I$, NaH; IV. $MePPh_3Br$, NaH

(b) I. MeI, NaH; II. active MnO_2; III. Me_3SI, NaH; IV. $MePPh_3Br$, NaH

(c) I. CH_2I_2, Zn-Cu; II. $MePPh_3Br$, NaH; III. active MnO_2; IV. MeI, NaH

(d) I. $MePPh_3Br$, NaH; II. active MnO_2; III. CH_2I_2, Zn-Cu; IV. MeI, NaH

116. Match the following:

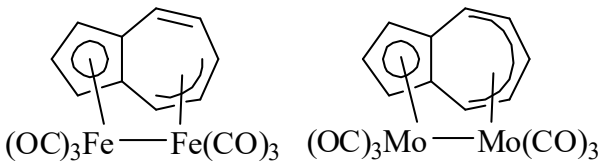
Measurement		Spectroscopic Technique	
A	Binding energy	I	NMR spectroscopy
B	Quadrupole splitting	II	Energy-dispersive X-ray spectroscopy (EDS)
C	Contact shift	III	X-ray photoelectron spectroscopy (XPS)
D	Elemental analysis	IV	Mössbauer spectroscopy

(a) (A) – (ii), (B) – (i), (C) – (iv), (D) – (iii) (b) (A) – (iii), (B) – (iv), (C) – (i), (D) – (ii)

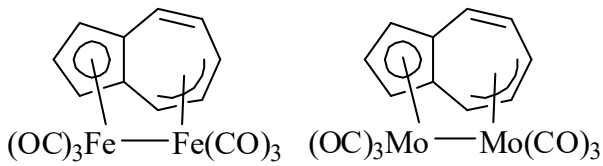
(c) (A) – (iv), (B) – (iii), (C) – (i), (D) – (ii) (d) (A) – (i), (B) – (iv), (C) – (ii), (D) – (iii)

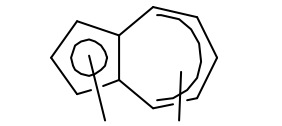
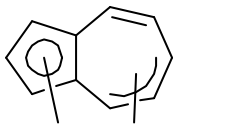
117. The set of structures showing the correct hapticity of azulene on the basis of the 18 e^- rule, is

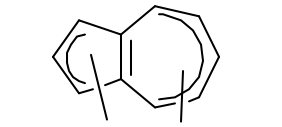
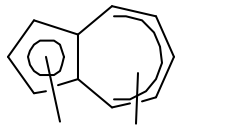
(a)



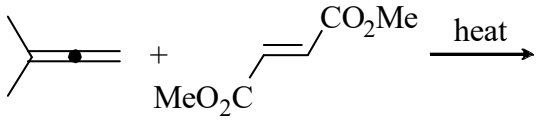
(b)

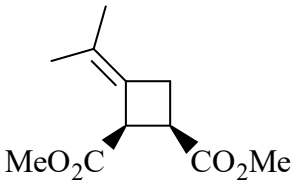


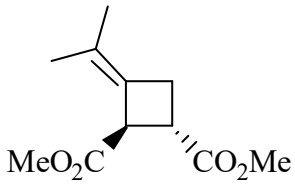
(c)  

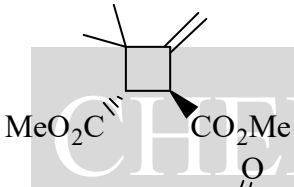
(d)  

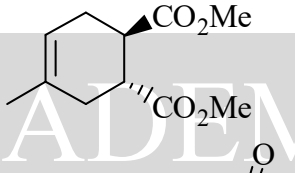
118. The major product formed in the following reaction is

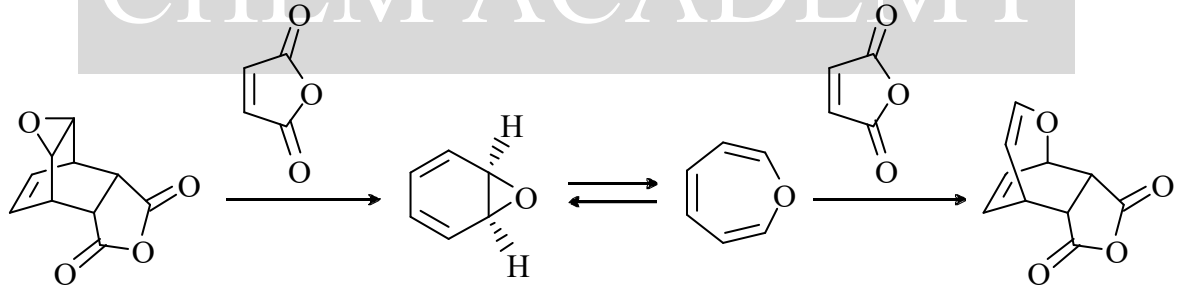


(a) 

(b) 

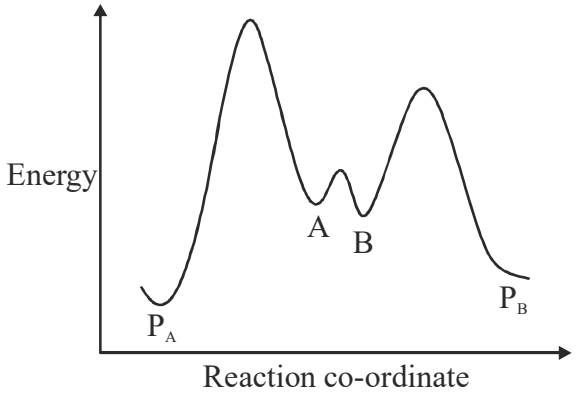
(c) 

(d) 

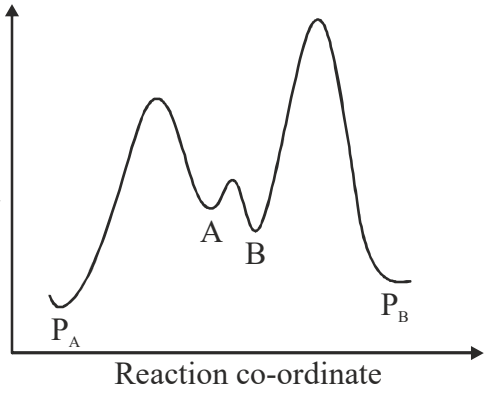
119. 

P_A A B P_B

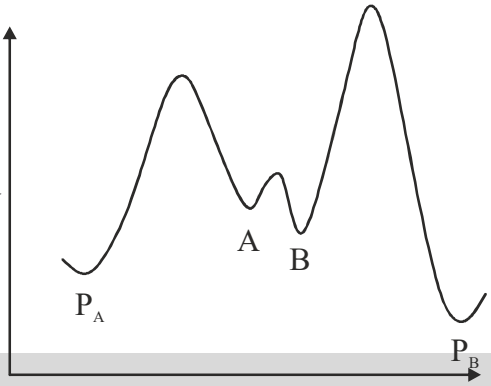
The correct energy profile diagram for the above reactions is

(a) 

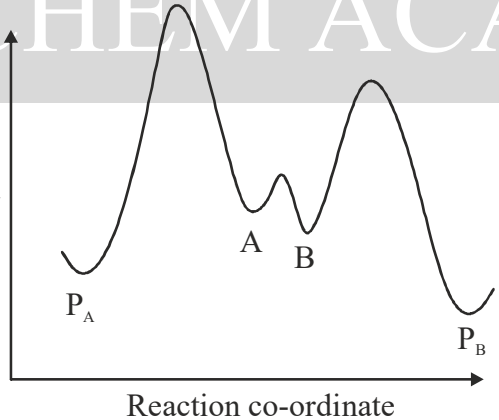
(b)



(c)



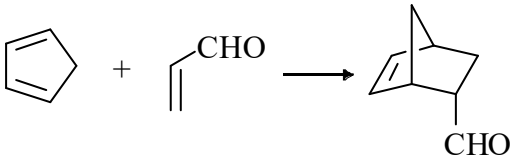
(d)



120. The reaction that will show a large increase in rate when the reaction medium is changed from a non-polar to polar organic solvent is

(a) $NMe_3 + Me_3\overset{\oplus}{S}\,\overset{\ominus}{Br} \longrightarrow Me_4\overset{\oplus}{N}\,\overset{\ominus}{Br} + Me_2S$

(b) $Et_3\overset{\oplus}{S}\,\overset{\ominus}{Br} \longrightarrow EtBr + Et_2S$

(c) 

(d) $NMe_3 + MeI \longrightarrow Me_4\overset{\oplus}{N}\,\overset{\ominus}{I}$