PAPER : CSIR-UGC-NET/JRF JUNE 2018

CHEMICAL SCIENCES BOOKLET-[A]

PART-B

21. Dinuclear anion $[I_2(OH)_2O_8]^{4-}$ has two bridging oxo groups. The geometry around each iodine is
(a) octahedral (b) monocapped octahedral
(c) square pyramidal (d) pentagonal bipyramidal

22. Using a double beam UV-visible spectrophotometer, Beer's law fails for $K_2Cr_2O_7$ solution when
(a) intensity of light source is changed (b) detector is not a photomultiplier tube
(c) cuvette of 2 cm size is used (d) pH is not kept same in all measurements

23. Trivalent lanthanide ion having isotropic magnetic susceptibility is
(a) Eu^{3+} (b) Gd^{3+} (c) Yb^{3+} (d) Lu^{3+}

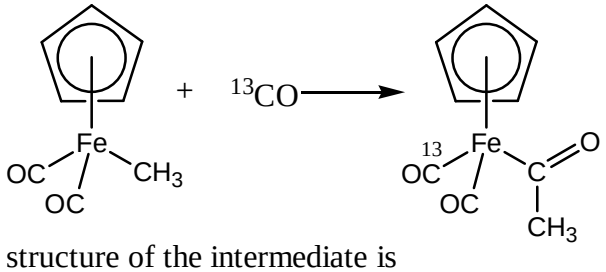
24. The structure of CaB_6 is close to that of
(a) cesium chloride (b) nickel arsenide (c) rock salt (d) zinc blende

25. The correct order of C–O bond length is
(a) $H_3B\cdot CO > \left[Mn(CO)_6\right]^+ > \left[Cr(CO)_6\right] > \left[V(CO)_6\right]^-$
(b) $\left[V(CO)_6\right]^- > \left[Cr(CO)_6\right] > \left[Mn(CO)_6\right]^+ > H_3B\cdot CO$
(c) $\left[Mn(CO)_6\right]^+ > H_3B\cdot CO > \left[V(CO)_6\right]^- > \left[Cr(CO)_6\right]$
(d) $\left[Cr(CO)_6\right] > \left[V(CO)_6\right]^- > H_3B\cdot CO > \left[Mn(CO)_6\right]^+$

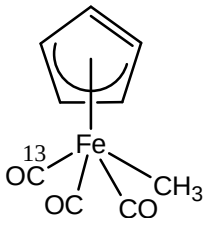
26. Among the elements Zn, Ga, Ge and As, the one with the lowest first ionisation energy is
(a) As (b) Zn (c) Ga (d) Ge

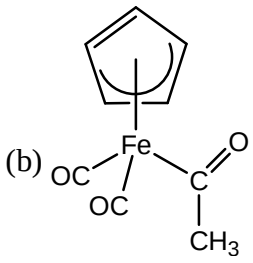
27. The total degeneracy of the ground term of Co^{II} (high spin) in octahedral geometry is
(a) 18 (b) 12 (c) 28 (d) 9

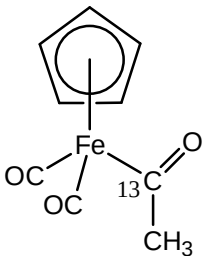
28. For the following reaction,

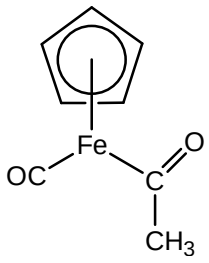


the structure of the intermediate is

(a) 

(b) 

(c) 

(d) 

29. High spin complex of a 3d metal ion **M** has a magnetic moment of 2.9 B.M. in octahedral coordination environment and 4.1 B.M. in tetrahedral environment. The **M** ion is
(a) Co^{III} (b) Ni^{II} (c) Cu^{II} (d) Co^{II}

30. For electronic spectra of K_2CrO_4 (A) and K_2MoO_4(B) the correct combination is
(a) transition is d-d and λ_{max} for A < B (b) transition is LMCT and λ_{max} for A < B
(c) transition is LMCT and λ_{max} for A > B (d) transition is MLCT and λ_{max} for A > B

31. Removal of an electron from NO molecule results in
(A) an increase in the $\nu(NO)$ in the IR spectrum
(B) an EPR active species
(C) electrons in HOMO's being closer to the oxygen than to nitrogen 2p orbitals
(D) electrons in HOMOs being closer to the nitrogen than to oxygen 2p orbitals
The correct answer is
(a) A only (b) A and C (c) B and D (d) A, B and C

32. Consider the nature of solvents in Column-I and the corresponding λ_{max} for I_2 in various solvents given in Column-II. (for I_2 vapor λ_{max} is 520 nm). Match Column-I with Column-II

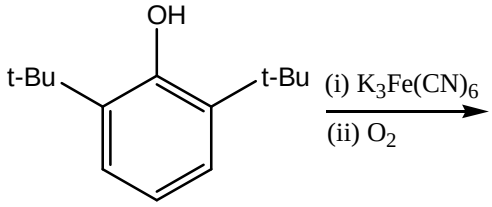
Column-I	**Column-II** (λ_{max}, nm)
(A) non-donor	(I) 520
(B) weak donor	(II) 500
(C) strong donor	(III) 450
(D) π electron donor	(IV) 360

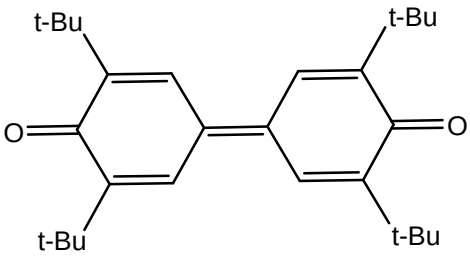
The correct match is
(a) A-I, B-II, C-III, D-IV (b) A-III, B-IV, C-II, D-I
(c) A-I, B-III, C-IV, D-II (d) A-IV, B-III, C-II, D-I

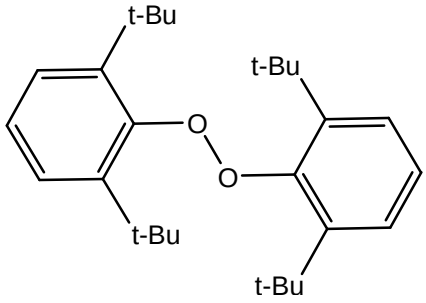
33. For the catalytic activity of Cu and Zn containing enzyme, superoxide dismutase, what is/are the correct statement(s)?
(A) Cu and Zn both are essential
(B) only Cu is essential
(C) Zn is essential and Cu may be replaced by any other divalent metal atom
(D) Zn may be replaced by any other divalent metal atom
(a) A only (b) C only (c) D only (d) B and D

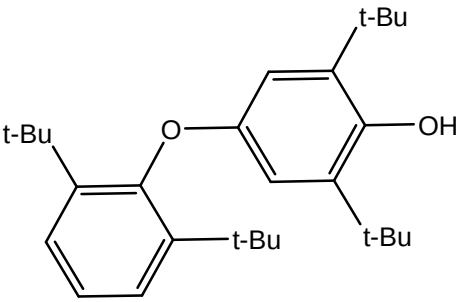
34. Mass spectrum of a compound shows an [M + 2] ion peak that is about 4% of M^+. This indicates that the compound has one
(a) fluorine (b) sulfur (c) bromine (d) chlorine

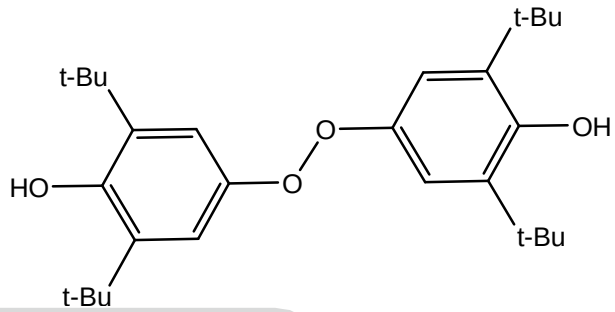
35. The major product formed in the following reaction is



(a) 

(b) 

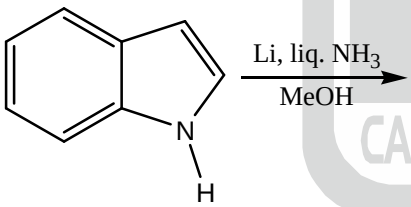
(c) 

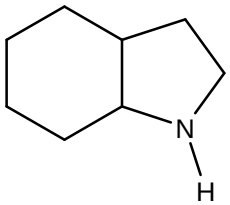
(d) 

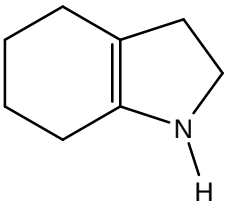
36. For the following compounds, the correct order of reactivity towards nucleophilic acyl substitution is

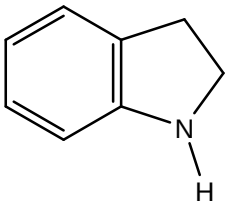
(a) acetyl chloride < methyl acetate < acetic anhydride < acetamide
(b) acetamide < methyl acetate < acetic anhydride < acetyl chloride
(c) acetamide < acetic anhydride < acetyl chloride < methyl acetate
(d) methyl acetate < acetamide < acetic anhydride < acetyl chloride

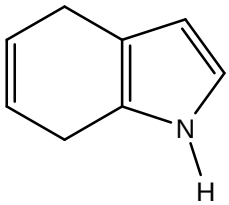
37. The major product formed in the following reaction



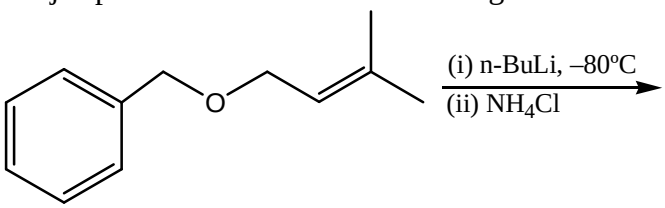
(a) 

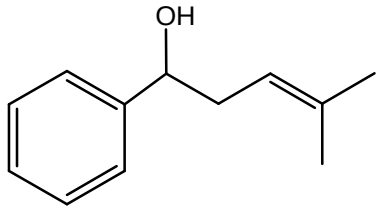
(b) 

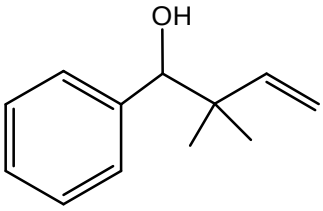
(c) 

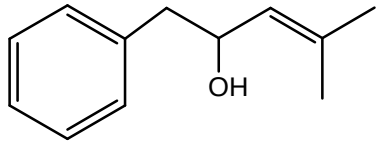
(d) 

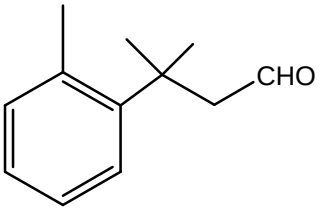
38. The major product formed in the following reaction is



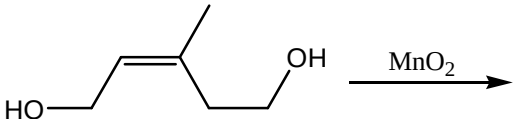
(a) 

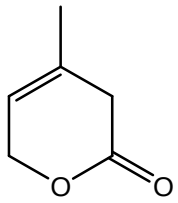
(b) 

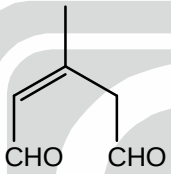
(c) 

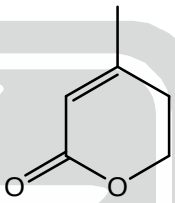
(d) 

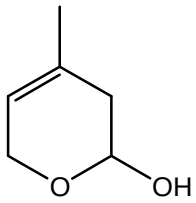
39. The major product formed in the following reaction is



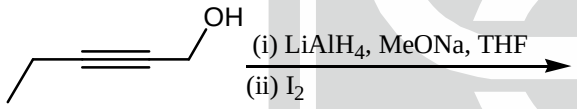
(a) 

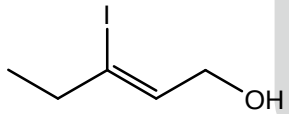
(b) 

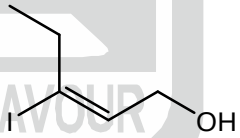
(c) 

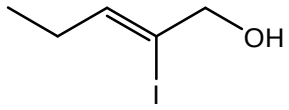
(d) 

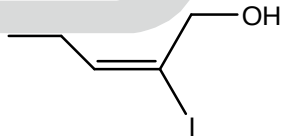
40. The major product formed in the following reaction is



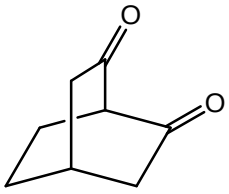
(a) 

(b) 

(c) 

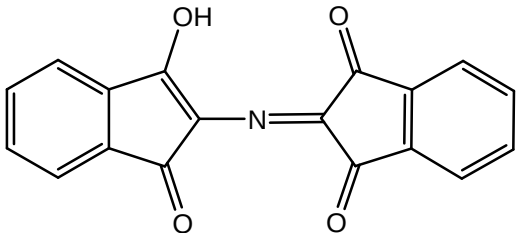
(d) 

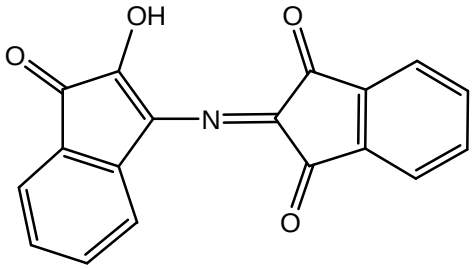
41. Number of signals observed in the ^{13}C NMR spectrum of the following compound is

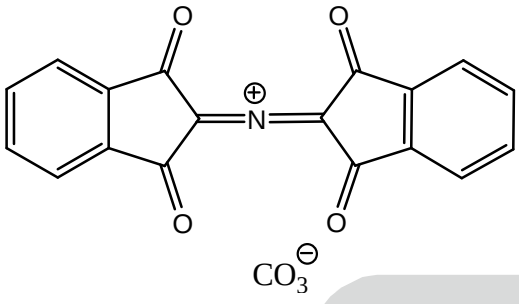


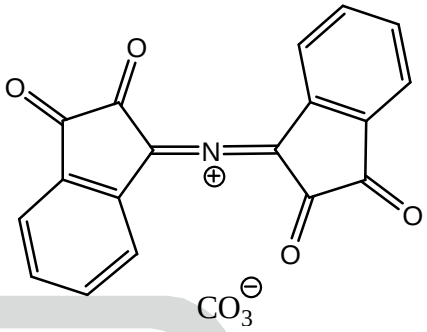
(a) 4 (b) 5 (c) 6 (d) 8

42. The structure of the product formed during the reaction of amino acid with ninhydrin is

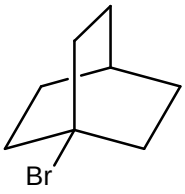
(a) 

(b) 

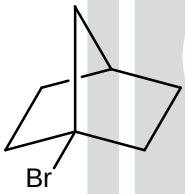
(c) 

(d) 

43. The correct order of rate of solvolysis in 80% ethanol at 25°C is



(A)

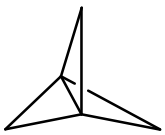


(B)

(C)

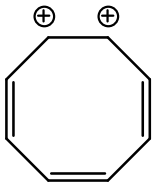
(a) B > C > A (b) A > B > C (c) C > B > A (d) C > A > B

44. IUPAC nomenclature of following propellane is

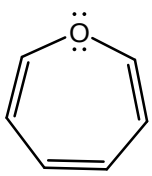


(a) tricyclo[1.1.1.$0^{2,4}$]pentane
(b) tricyclo[1.1.0.$1^{1,3}$]pentane
(c) tricyclo[1.1.$1^{1,3}$.$0^{1,5}$]pentane
(d) tricyclo[1.1.1.$0^{1,3}$]pentane

45. The correct statement about following species is



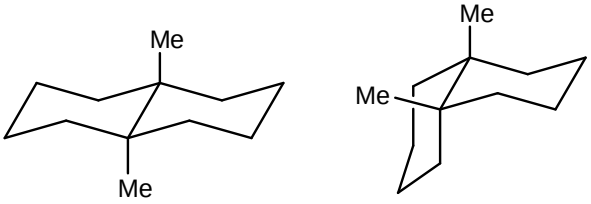
(A)



(B)

(a) Both A and B are aromatic
(b) A is aromatic and B is antiaromatic
(c) A is non-aromatic and B is antiaromatic
(d) A is aromatic and B is homoaromatic

46. The correct statement about the following compounds is



(A) **(B)**

(a) A is more stable than B (b) B is more stable than A
(c) A and B are equally stable (d) A and B are both locked conformations

47. In the pure Raman rotational spectrum of $^{16}O_2$, whose electronic ground state is $^3\Sigma_g^-$, transitions to/from
(a) even J levels are missing (b) odd J levels are missing
(c) all J levels appear (d) none of the J levels appear

48. Elementary steps of a reaction are as follows

$$A + B \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} 2C \; ; \quad 2C \xrightarrow{k_2} D$$

If steady state approximation is applicable to C, the rate of product formation in the reaction is
(a) proportional to [A][B] (b) proportional to $[A]^2[B]^2$
(c) proportional to $[A]^{½}[B]^{½}$ (d) independent of [A][B]

49. The term symbol for the ground state of B_2 is
(a) $^1\Sigma_g^+$ (b) $^1\Sigma_g^-$ (c) $^3\Sigma_g^-$ (d) $^3\Sigma_g^+$

50. A Gaussian distribution has the functional form $f(x) = \frac{2}{\sqrt{2a^2\pi}} e^{-(x-b)^2/2a^2}$. The variance of such distribution is
(a) a (b) a^2 (c) b (d) b^2

51. The change in entropy for a reversible adiabatic process is
(a) maximum (b) minimum (c) zero (d) positive

52. The standard cell potential for the reaction

$$Zn(s) + Cu^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Cu(s)$$

is +1.10 V. The Gibbs free energy change during the reaction is
(F = 96500 coulomb mol^{-1})
(a) –21.2 kJ mol^{-1} (b) +212 kJ mol^{-1} (c) –212 kJ mol^{-1} (d) –212 J mol^{-1}

53. If the unit of the rate constant of a reaction is $L^3mol^{-3}s^{-1}$, the order of the reaction is
(a) 1 (b) 2 (c) 3 (d) 4

54. The lowest energy state of a $1s^12s^1$ electronic configuration, according to Hund's rule is
(a) $^3S_0$ (b) $^1S_0$ (c) $^3S_1$ (d) $^1S_1$

55. The commutator of $\hat{x}$ with the Hamiltonian $\hat{H}$, $\left[\hat{x}, \hat{H}\right]$, is
(a) 0 (b) $i\hbar$ (c) $\frac{-\hbar^2}{2m}\hat{p}_x$ (d) $\frac{i\hbar}{m}\hat{p}_x$

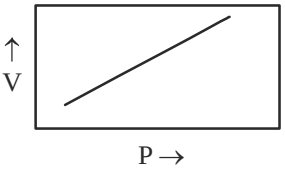
56. A 5 g/L polymer solution is prepared with a polymer whose molar mass is 25 kg. The osmotic pressure (in atm) of this solution at 25°C is (consider RT = 2500 $Jmole^{-1}$)
(a) 0.002 (b) 0.05 (c) 0.005 (d) 0.008

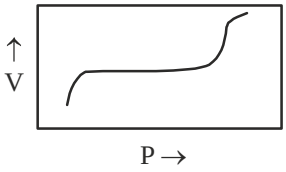
57. If all the lattice points of an FCC structure are occupied by uniform hard spheres that touch each other, the fraction of volume occupied is

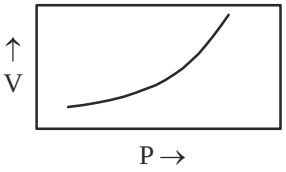
(a) $\frac{\pi\sqrt{2}}{6}$ (b) $\frac{\pi\sqrt{3}}{6}$ (c) $\frac{\pi}{6}$ (d) $\frac{2\pi}{6}$

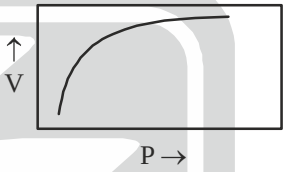
58. Origin of the colligative properties of a dilute solution is
(a) volatility of solute molecule (b) interaction of solute-solvent molecules
(c) zero enthalpy of mixing (d) entropy of mixing

59. The graph that represents the Langmuir adsorption isotherm is

(a) 

(b) 

(c) 

(d) 

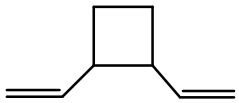
60. Correct match for the coenzymes in Column-A with their function in Column-B is

Column-A	**Column-B**
(P) NADH	(I) Oxidation
(Q) FAD	(II) Acyl group transfer
(R) CoASH	(III) Reduction

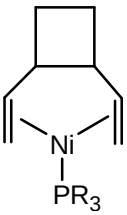
(a) P-I, Q-II, R-III (b) P-III, Q-I, R-II (c) P-III, Q-II, R-I (d) P-II, Q-I, R-III

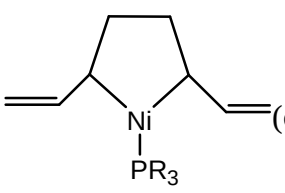
PART-C

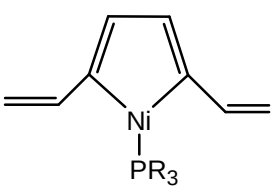
61. One of the products formed in the bis$\left(\eta^3\text{-allyl}\right)$ nickel complex catalyzed cyclo-dimerization of butadiene in the presence of PR_3 is compound A given below. Identify its percursor.

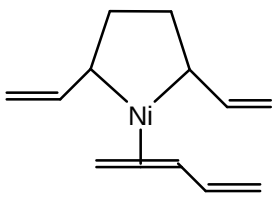


(A)

(a) 

(b) 

(c) 

(d) 

62. The transformation are given in **Column-I** and reagent in **Column-II**. Match the items of **Column-I** with those of **Column-II**

Column-I	**Column-II**
(A) $[MnO_4]^- \rightarrow [MnO_4]^{2-}$	(I) H_2SO_4
(B) $Me_3CH \rightarrow [Me_3C]^+$	(II) Na in liquid NH_3
(C) $Ag + Au \rightarrow Ag[AuF_4]$	(III) $[H_2SO_3F]^+$ (super acid)
(D) $H_3PO_4 \rightarrow [P(OH)_4]^+$	(IV) Liquid BrF_3

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-II, C-I, D-IV (d) A-III, B-I, C-IV, D-II

63. Consider the following statements for the oxygenation of hemocyanine

(A) oxidation state of both copper atoms changes by two

(B) it becomes intense blue from colourless

(C) dioxygen is reduced to O_2^{2-}

(D) the μ-$\eta^2:\eta^2$ bond forms between each oxygen and copper atoms.

The correct statements are

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

64. The correct increasing order of C–C bond length in the following molecules (A-D)

$[PtCl_3(C_2H_4)]^-$ (A), $[Pt(PPh_3)_2(C_2H_4)]$ (B), $[Pt(PPh_3)_2\{C_2(CN)_4\}]$ (C), is

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

65. Which of the following are NOT closo clusters?

$[\{Co(\eta^5\text{-}C_5H_5)\}_2(C_2B_6H_8)]$ (A), $[B_4C_2H_8]$ (B), $[B_{10}H_{13}\{Au(PPh_3)\}]$ (C), $[C_2B_8H_{10}]$ (D)

The correct answer is

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

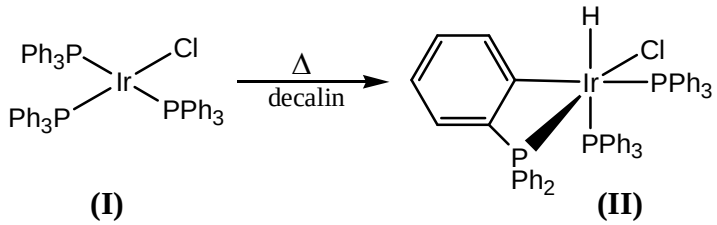
66. Identify the pair of molecules which are isoelectronic as well as isostructural from the following:

$[Pd(PPh_3)_4]$ (**A**), $[V(CO)_6]$ (**B**), $[Cr(CO)_6]$ (**C**), $[Rh(PPh_3)_3Cl]$ (**D**),

$[(\eta^5\text{-}C_5H_5)Ni(NO)]$ (**E**), $Ni(CO)_4$ (**F**)

(a) B and C (b) A and F (c) A and D (d) C and E

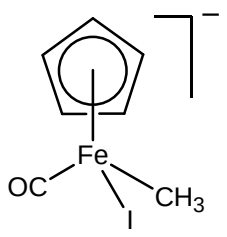
67. For the following reaction, correct statement(s) is/are

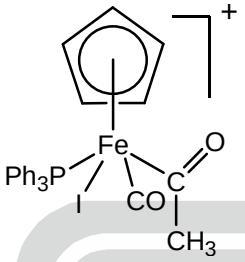


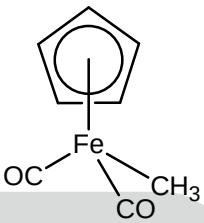
(I) **(II)**

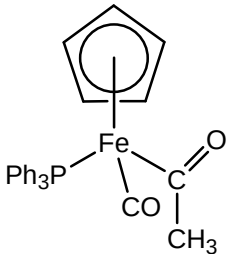
(A) Oxidation state of iridium increases from I to III
(B) It is β-hydride elimination reaction
(C) I and II both are diamagnetic
(D) It is migratory insertion reaction
The correct answer is
(a) A only (b) A and C (c) C and D (d) B, C and D

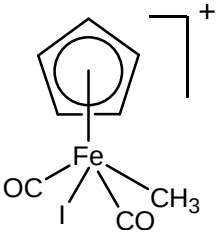
68. The reaction $\left[\left(\eta^5\text{-}C_5H_5\right)Fe(CO)_2\right]^-$ with CH_3I gives compound **A**. The ^1H NMR spectrum of **A** shows two singlets in an integrated intensity ratio of **3 : 5**. Compound **A** upon reaction with PPh_3 gives compound **B**. The ^1H NMR spectrum of **B** shows 3 sets of signals in an integrated intensity ratio of **3 : 5 : 15**. Compounds **A** and **B** respectively, are

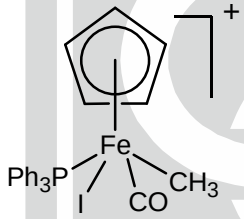
(a) 

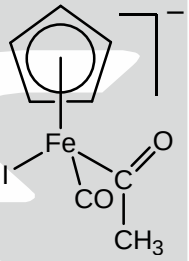
, 

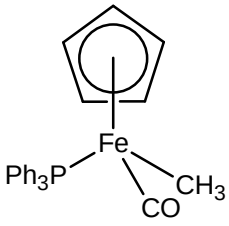
(b) 

, 

(c) 

, 

(d) 

, 

69. Identify the correct statements about the electronegativity of groups given below.
(A) CF_3 group has greater value than that of NF_2
(B) NH_2 group has lower value than that of NF_2
(C) OH group has greater value than that of NF_2
(D) CH_3 and C_2H_5 groups have almost similar values
Correct answer is
(a) A, B and D (b) B and C (c) B, C and D (d) B and D

70. Height equivalent to theoretical plate (HETP) in gas-liquid chromatography depends significantly on which of the following?
(A) Temperature of column (B) Velocity of carrier gas
(C) Packing of column (D) Column material
Correct answer is
(a) A, B and C (b) C and D (c) B, C and D (d) A and C

71. A binary fluoride **Z** of xenon combines with two moles of NaF to give a product which on heating to 100ºC affords compound **A**. The alkaline hydrolysis of **A** gives perenate salt. **Z** and **A** are, respectively
(a) XeF_2 and XeF_4 (b) XeF_4 and XeF_6
(c) XeF_6 and XeF_4 (d) XeF_6 and XeF_6

72. Match fluorescence colours given in **Column- A** with lanthanide ions given in **Column-B**

Column-A	**Column-B**
(I) Pink	(A) Sm(III)
(II) Red	(B) Tb(III)
(III) Green	(C) Eu(III)
(IV) Blue	(D) Tm(III)

Correct match is

(a) I-A, II-C, III-B, IV-D (b) I-D, II-C, III-B, IV-A
(c) I-A, II-B, III-C, IV-D (d) I-C, II-B, III-D, IV-A

73. Choose the correct set of statements for *cis*-platin.
(A) It can be prepared from $K_2[PtCl_4]$
(B) It can be prepared from $[Pt(NH_3)_4]Cl_2$
(C) In its preparation, the observed *trans* effect for Cl^- is greater than that of NH_3.
(D) In blood it stays in equilibrium with cis-$[Pt(NH_3)_2Cl(H_2O)]^+$
(E) In DNA strand, it binds to two adjacent cytosine bases
The correct set is
(a) A, C and D (b) A, C, D and E (c) B, C and D (d) B, C, D and E

74. In fission of ^{235}U atom the energy released is 200 MeV. In one day fission of 1kg ^{235}U will give power (in MW) approximately
(a) 550 (b) 650 (c) 950 (d) 1250

75. The structures of $[Re_2Cl_8]^{2-}$ (**A**) and $[Os_2Cl_8]^{2-}$ (**B**) are made up of two MCl_4 units. For these structures, which statement is correct?
(a) (**A**) and (**B**) both have MCl_4 units eclipsed
(b) (**A**) and (**B**) both have MCl_4 units staggered
(c) (**A**) has both MCl_4 units staggered and (**B**) has both MCl_4 unit eclipsed
(d) (**A**) has both MCl_4 units eclipsed and (**B**) has both MCl_4 units staggered.

76. For the Wacker process, pick the correct statement(s) from the following
(A) Pd(II) is reduced to Pd(0) by Cu(I)
(B) Pd(0) is oxidized to Pd(II) by Cu(II)
(C) Cu(II) promotes the reductive elimination
Correct answer is
(a) A and C (b) B and C (c) A and B (d) B only

77. Consider the following statements
(I) **$AsCl_5$** is thermally less stable than **PCl_5**
(II) Size of **As** is more than that of **P**
Choose the correct answer from the following
(a) Statements I and II are true and II is the correct explanation of I
(b) Statements I and II are true but II is not the correct explanation for I
(c) Statement I is true and statement II is false
(d) Both the statements I and II are false.

78. Consider the following statements for Be_2Cl_4 (I), B_2Cl_4 (II) and Ga_2Cl_4 (III):
(A) There is an M–M (M = Be, B, Ga) bond in all
(B) The oxidation state of Be, B and Ga is +2
(C) The oxidation around the central atom is planar for all
(D) The geometry around the central atom is planar in I and II only
The correct statement(s) is/are
(a) A, B and C (b) A and B (c) D only (d) B, C and D

79. Consider the following statements
(A) Cr^{2+} is easier to oxidise than V^{2+} in the gas phase
(B) $Cr^{2+}(aq)$ is a more powerful reducing agent than $V^{2+}(aq)$
(C) The rate of water exchange for $Cr^{2+}(aq)$ is much faster than for $V^{2+}(aq)$
The correct statements are
(a) A and B (b) A and C (c) B and C (d) A, B and C

80. Consider the statements A-D regarding equation **I-III**:

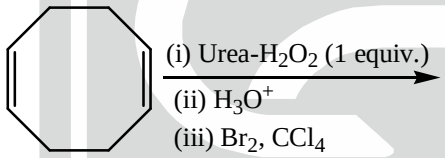
(I) $\left[Fe(CN)_6\right]^{3-} + \left[Co(CN)_5\right]^{3-} \rightarrow \left[Fe(CN)_6\right]^{4-} + \left[Co(CN)_5\right]^{2-}$

(II) $\left[Co(bipy)_3\right]^{2+} + \left[Co^{*}(bipy)_3\right]^{3+} \rightarrow \left[Co(bipy)_3\right]^{3+} + \left[Co^{*}(bipy)_3\right]^{2+}$

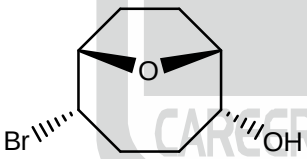
(III) $\left[Co(NH_3)_5F\right]^{2+}\left[Cr(H_2O)_6\right]^{2+} \rightarrow \left[Co(NH_3)_5(H_2O)\right]^{2+} + \left[Cr(H_2O)_5F\right]^{2+}$

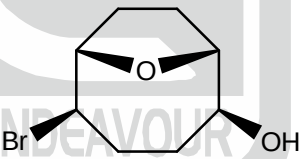
(A) Marcus equation is applicable to I and II
(B) Marcus equation is applicable to II only
(C) Equations I and II involve inner sphere electron transfer
(D) Equations I and III involve inner sphere electron transfer
The correct statements are
(a) A and B (b) B and C (c) B and D (d) C and D

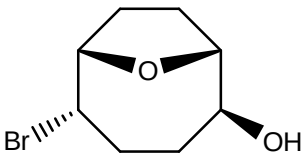
81. The major product formed in the following oxidation reaction is



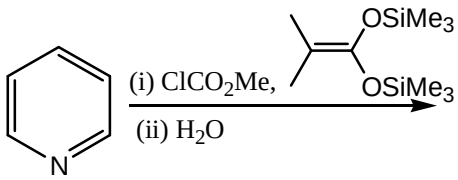
(a) 

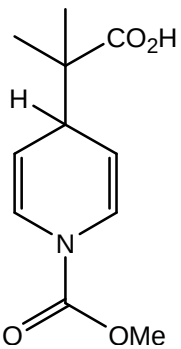
(b) 

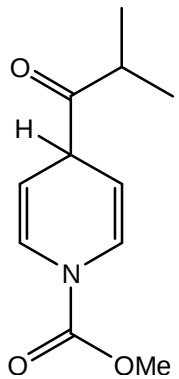
(c) 

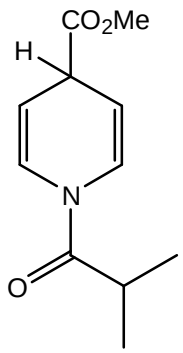
(d) 

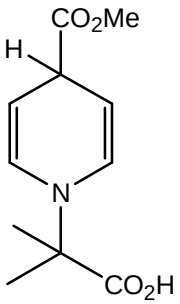
82. The major product formed in the following reaction is



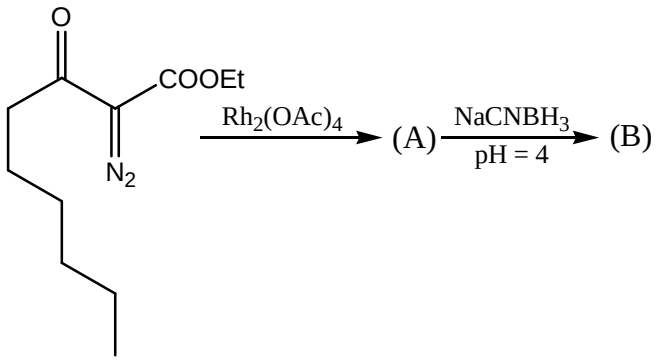
(a) 

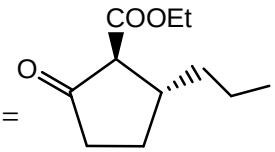
(b) 

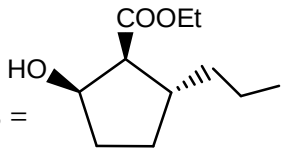
(c) 

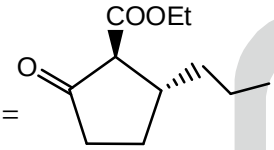
(d) 

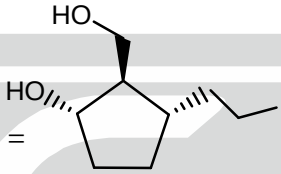
83. The major products A and B formed in the following reaction sequence are

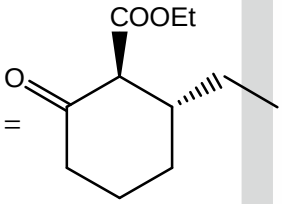


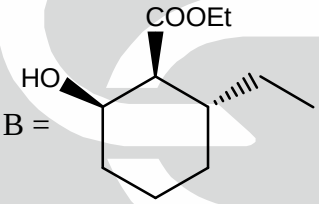
(a) A = 

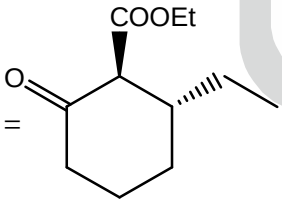
B = 

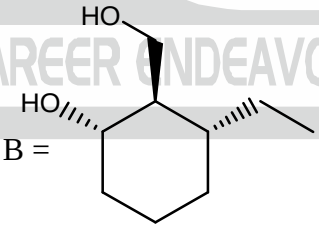
(b) A = 

B = 

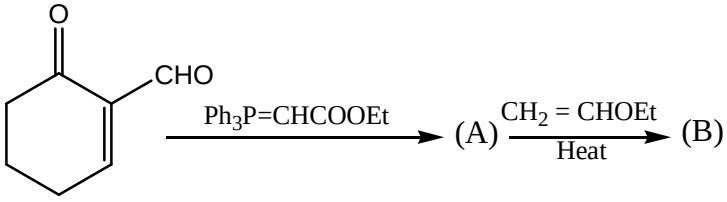
(c) A = 

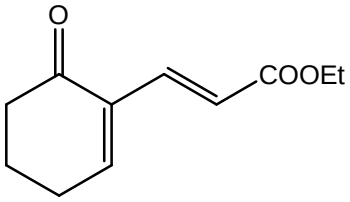
B = 

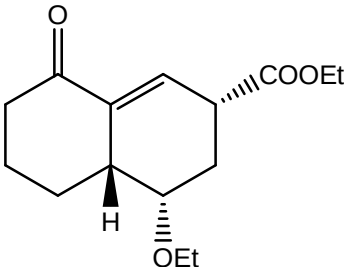
(d) A = 

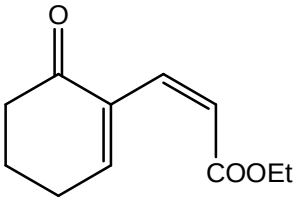
B = 

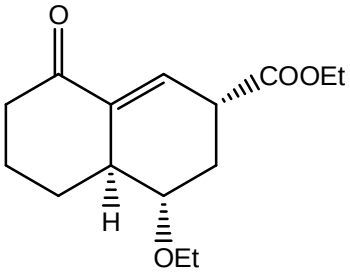
84. The major products (A) and (B) formed in the following reaction sequence are

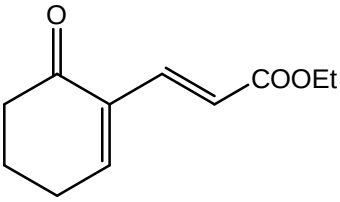


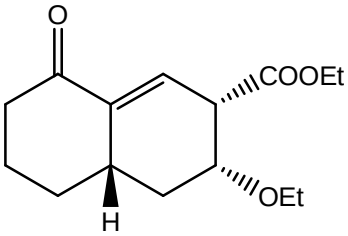
(a) A = 

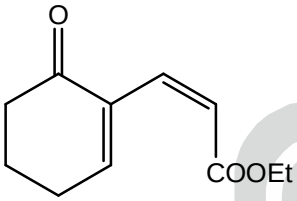
B = 

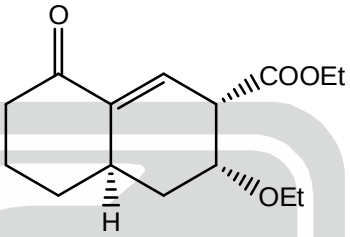
(b) A = 

B = 

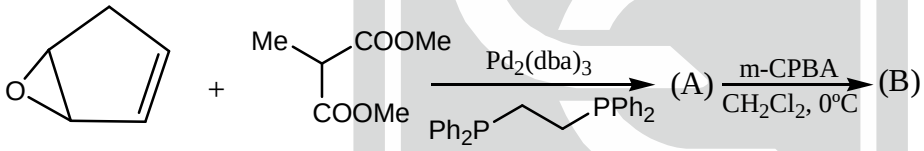
(c) A = 

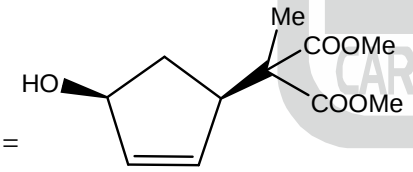
B = 

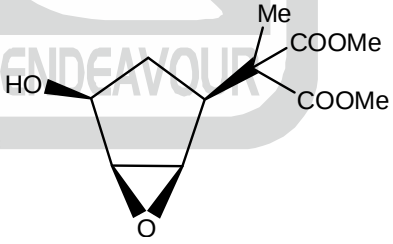
(d) A = 

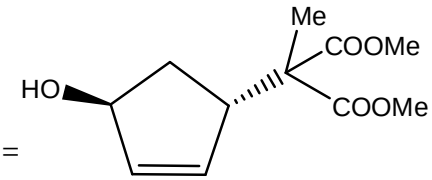
B = 

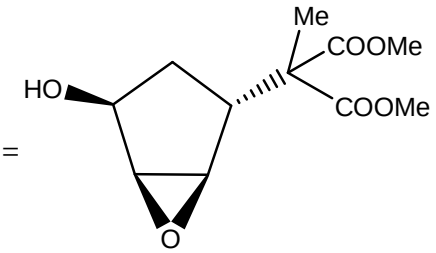
85. Structure of the intermediate A and the final product B in the following reaction sequence are (dba = dibenzylidene acetone)

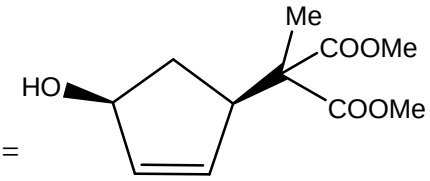


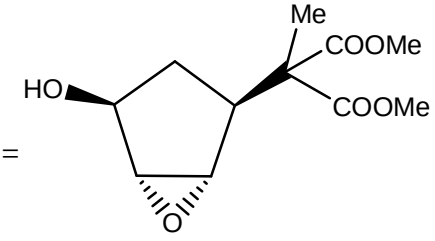
(a) A = 

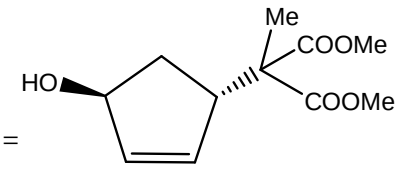
B = 

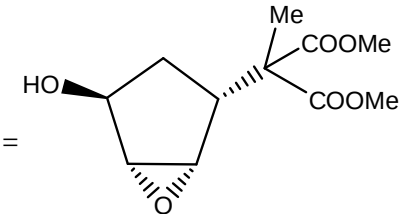
(b) A = 

B = 

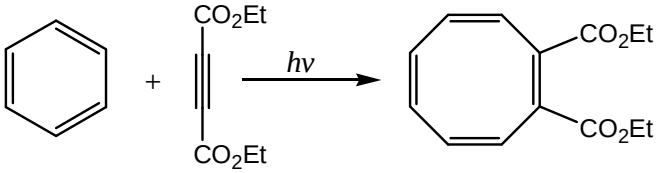
(c) A = 

B = 

(d) A = 

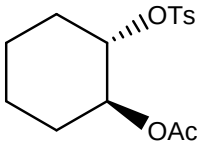
B = 

86. Mechanism of the following transformation involves

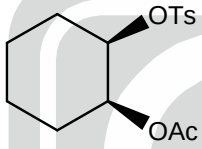


(a) A [2+2] cycloaddition followed by '*con*' rotatory electrocyclic ring opening
(b) A [4+2] cycloaddition followed by '*con*' rotatory electrocyclic ring opening
(c) A [4+2]cycloaddition followed by *cope* rearrangement
(d) A [2+2] cycloaddition followed by '*dis*' rotatory electrocylic ring opening.

87. The correct statement about solvolysis using NaOAc/AcOH of following compounds is



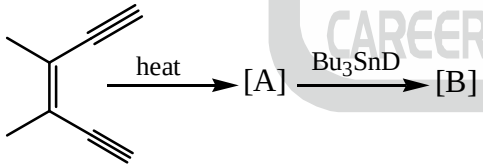
(A)

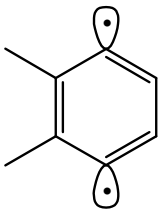
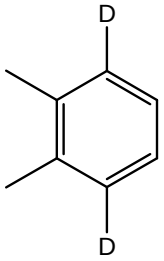


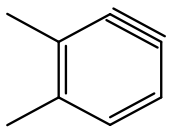
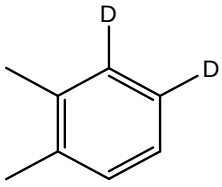
(B)

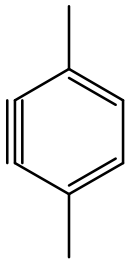
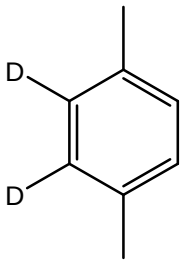
(a) A reacts faster than B to give trans-1, 2-diacetoxycyclohexane
(b) B reacts faster than A to give trans-1, 2-diacetoxycyclohexane
(c) A reacts faster than B to give cis-1, 2-diacetoxycyclohexane
(d) B reacts faster than A to give cis-1, 2-diacetoxycyclohexane

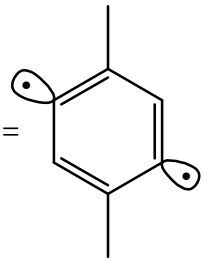
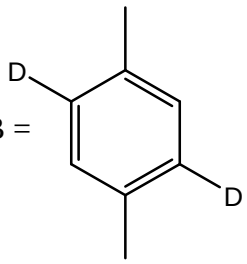
88. The structure of the intermediate A and the major product B formed in the following reaction are



(a) A = 
B = 

(b) A = 
B = 

(c) A = 
B = 

(d) A = 
B = 

89. A compound shows following spectral data:

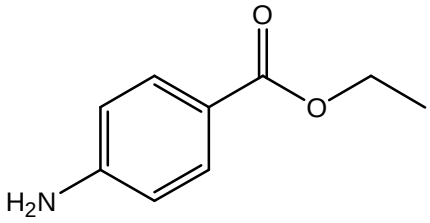
^{1}H NMR : δ 7.9(d, J = 8 Hz, 2 H), 6.6(d, J = 8 Hz, 2 H),

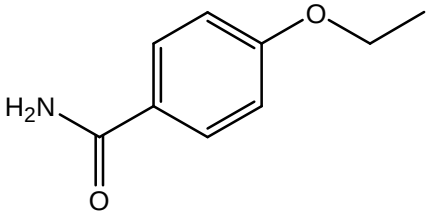
4.3(q, J = 6 Hz, 2 H), 4.0(br s, 2 H, D_2O exchangeable),

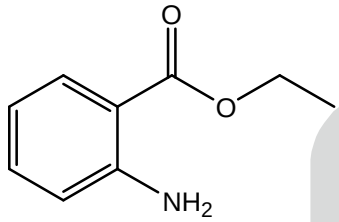
1.4(t, J = 6 Hz, 3 H)

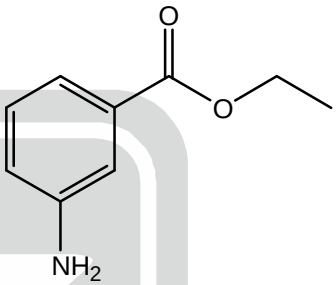
Mass : m/z 165, 137, 120, 92

The correct structure of the compound is

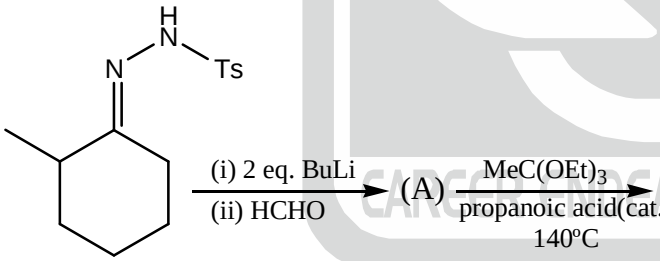
(a) 

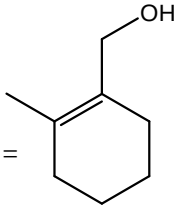
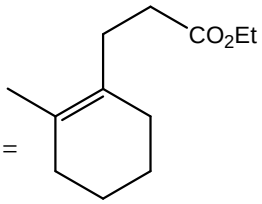
(b) 

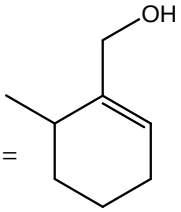
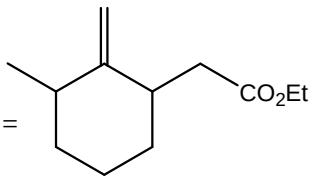
(c) 

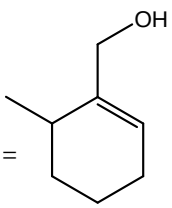
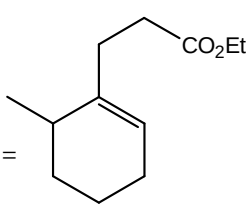
(d) 

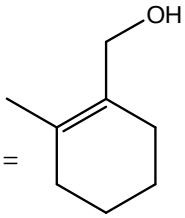
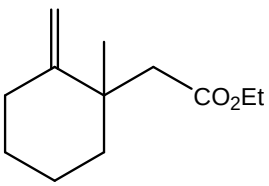
90 The major allylic alcohol A and the ester B formed in the following reaction sequence are



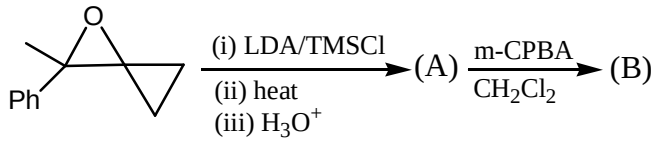
(a) A =  B = 

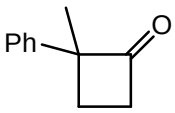
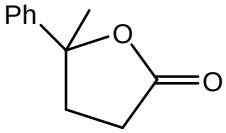
(b) A =  B = 

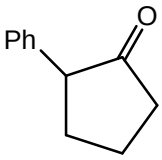
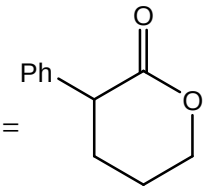
(c) A =  B = 

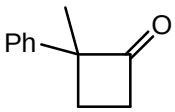
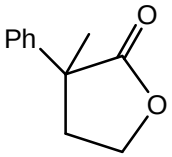
(d) A =  B = 

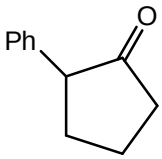
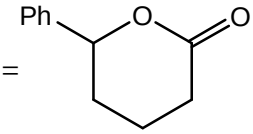
91. The major products A and B formed in the following reaction sequence are



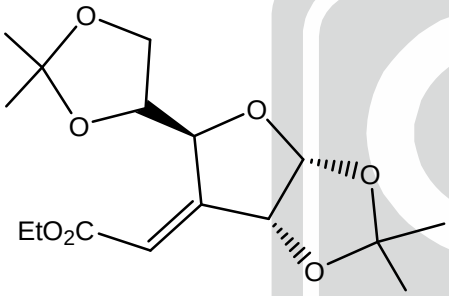
(a) A =  B = 

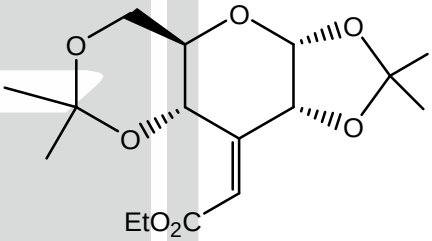
(b) A =  B = 

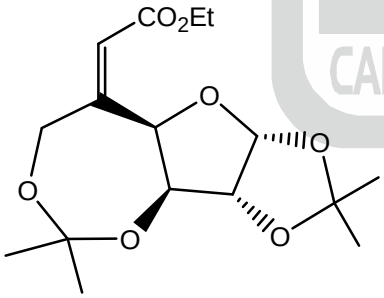
(c) A =  B = 

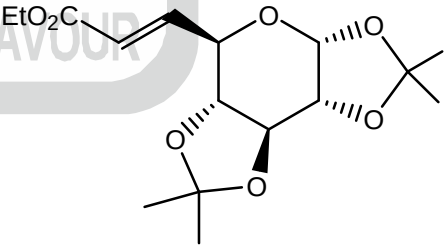
(d) A =  B = 

92. Reaction of D-glucose with following reagents produces
Reagents : (1) Acetone, H^+ ; (2) PDC; (3) $(EtO)_2P(O)CH_2CO_2Et$, NaH

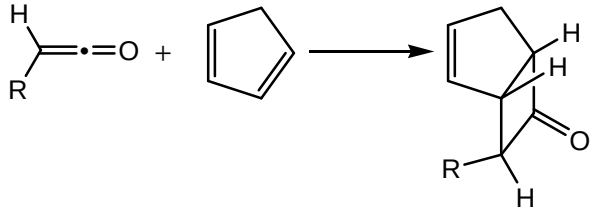
(a) 

(b) 

(c) 

(d) 

93. For the following thermal [2+2] cycloaddition reaction, the correct statement about Transition State (TS) and preference for endo product formation is



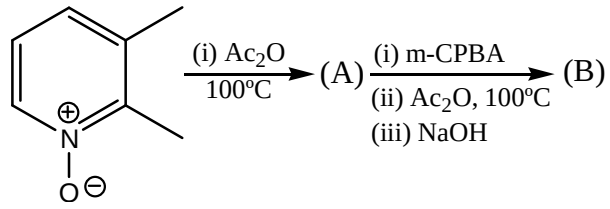
(a) $TS: \pi_{2s} + \pi_{2s}$; Me > i-Pr > t-Bu

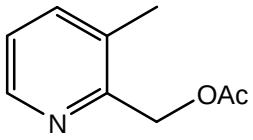
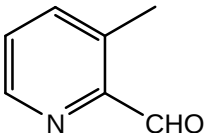
(b) $TS: \pi_{2s} + \pi_{2a}$; t-Bu > i-Pr > Me

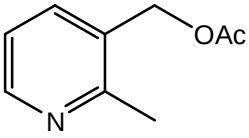
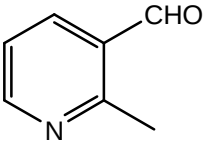
(c) $TS: \pi_{2s} + \pi_{2a}$; Me > i-Pr > t-Bu

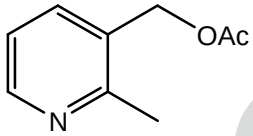
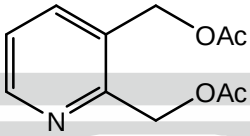
(d) $TS: \pi_{2s} + \pi_{2s}$; t-Bu > i-Pr > Me

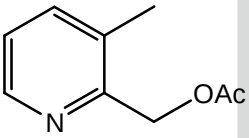
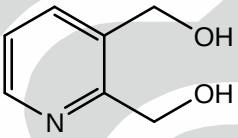
94. The major products A and B formed in the following reaction sequence are



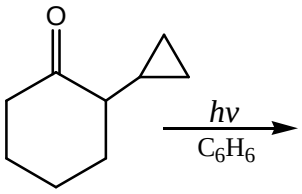
(a) A =  B = 

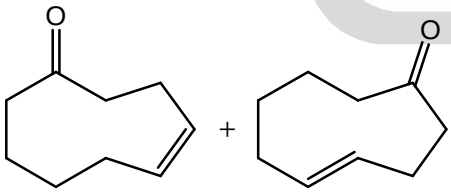
(b) A =  B = 

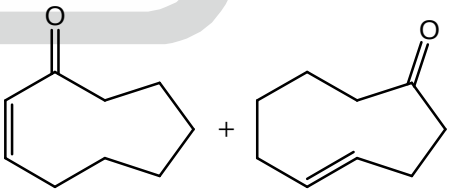
(c) A =  B = 

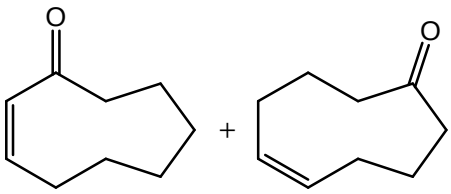
(d) A =  B = 

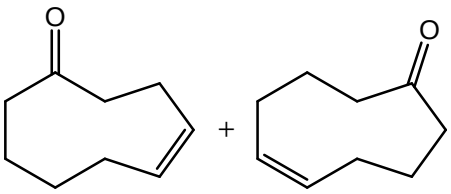
95. The major product formed in the following photochemical reaction are



(a) 

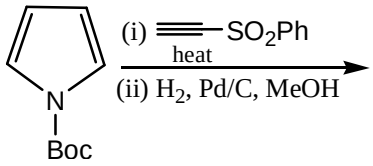
(b) 

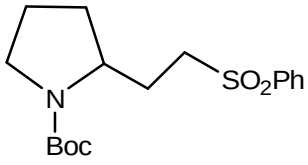
(c) 

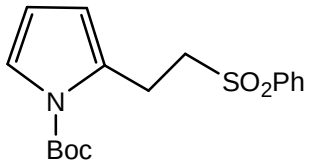
(d) 

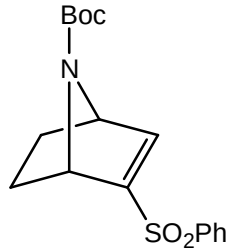
96. Irradiation of either cis-or trans-stilbene at 313 nm results in the formation of a mixture of 93% cis and 7% trans olefin because
(a) trans-stilbene is more stable than cis-stilbene
(b) the extinction coefficient trans-stilbene is greater than cis-stilbene at exciting wavelength
(c) the transition state structures of cis- and trans-stilbenes are different
(d) the triplet excited states of cis- and trans-stilbenes are at different energy levels.

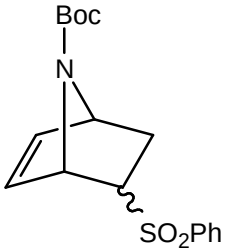
97. The major heterocyclic compound formed in the following reaction is



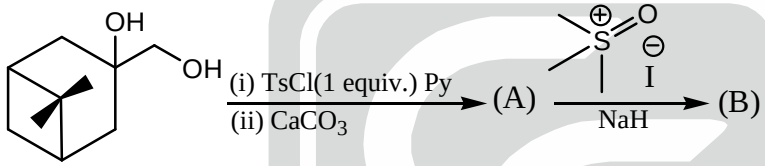
(a) 

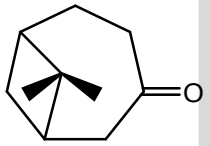
(b) 

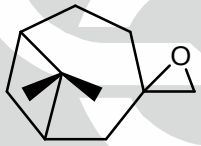
(c) 

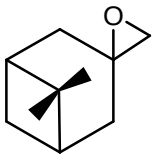
(d) 

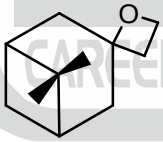
98. The major products A and B formed in the following reaction sequence are

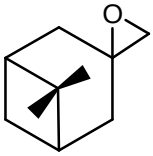


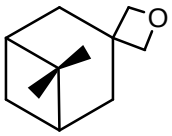
(a) A = 

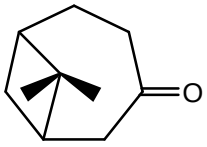
B = 

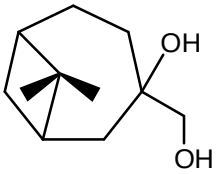
(b) A = 

B = 

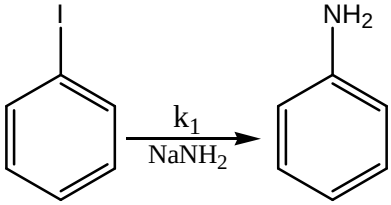
(c) A = 

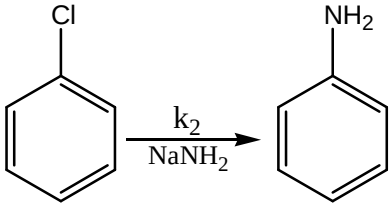
B = 

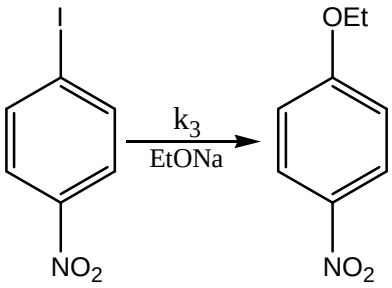
(d) A = 

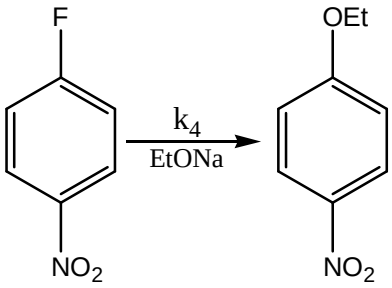
B = 

99. The correct order of rates for the following reactions is



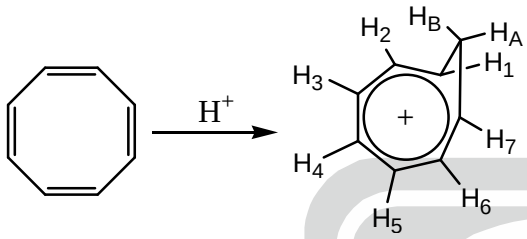






(a) $k_1 > k_2$ and $k_3 > k_4$
(b) $k_1 > k_2$ and $k_4 > k_3$
(c) $k_2 > k_1$ and $k_3 > k_4$
(d) $k_2 > k_1$ and $k_4 > k_1$

100. The correct match of protons in Column-A with the ^1H NMR chemical shifts in Column-B for the product of the following reaction is



Column-A	Column-B $(\delta$ **ppm**$)$
(P) H_A	(I) –0.3
(Q) H_B	(II) 5.1
(R) $H_{1\&7}$	(III) 6.4
(S) $H_{2\text{-}6}$	(IV) 8.5

(a) P-II, Q-I, R-III, S-IV
(b) P-I, Q-II, R-IV, S-III
(c) P-IV, Q-I, R-III, S-II
(d) P-II, Q-IV, R-I, S-III

101. Which of these is not a suitable unnormalized wave function for the excited $1s^12s^1$ electron configuration of the helium atom?

(a) $\left[1s(1)2s(2)-2s(1)1s(2)\right]\left[\beta(1)\beta(2)\right]$

(b) $\left[1s(1)2s(2)+2s(1)1s(2)\right]\left[\alpha(1)\beta(2)-\beta(1)\alpha(2)\right]$

(c) $\left[1s(1)2s(2)-2s(1)1s(2)\right]\left[\alpha(1)\beta(2)+\beta(1)\alpha(2)\right]$

(d) $\left[1s(1)2s(2)+2s(1)1s(2)\right]\left[\alpha(1)\beta(2)\right]$

102. Two opposite sides (in the y-direction) of a square box of side L are slightly stretched. Consider the following four statements
(A) The point group changes from D_{4h} to D_{2h}.
(B) The (1, 2) and (2, 1) energy levels remain doubly degenerate
(C) Both the energy levels are lowered and the energy of the (1, 2) level is higher than that of the (2, 1) level.
(D) Both the energy levels are lowered and the energy of the (1, 2) level is lower than that of the (2, 1) level
The two correct statements are
(a) A and B (b) A and C (c) B and C (d) A and D

103. Consider a model system of five non-interacting fermions in a single 3-dimensional harmonic oscillator. The Hamiltonian of a single particle is

$$\hat{H} = \frac{1}{2m}\left(\hat{p}_x^2 + \hat{p}_y^2 + \hat{p}_z^2\right) + \frac{1}{2}m\omega^2\left(x^2 + y^2 + z^2\right)$$

where m is the mass of the partice, ω is the angular frequency, $\hat{p}_x, \hat{p}_y$ and $\hat{p}_z$ are the momentum operators. The ground state energy of the system of 5 non-interacting fermions is

(a) $\frac{21}{2}\hbar\omega$ (b) $\frac{15}{2}\hbar\omega$ (c) $\frac{5}{2}\hbar\omega$ (d) $\frac{25}{2}\hbar\omega$

104. A particle is in a state $\phi = \psi_1 + 3\psi_2$, where ψ_1 and ψ_2 are eigenfunctions of the Hamiltonian of the particle with eigenvalues E_1 and E_2, respectively. The average energy of the particle in the state ϕ is

(a) $\left(E_1 + 9E_2\right)/10$ (b) $\left(E_1 + 3E_2\right)$

(c) $\left(E_1 + 9E_2\right)/4$ (d) $\left(E_1 + 3E_2\right)/10$

105. Which of the following statements on ground state perturbation theory, involving the zeroth order energy $E_0^{(0)}$, first order energy correction $E_0^{(1)}$ and second order energy correction $E_0^{(2)}$, is false?

(a) $E_0^{(1)}$ is the average value of perurbation operator with respect to the ground state of the zeroth order Hamiltonian

(b) $E_0^{(1)}$ is necessarily negative

(c) $E_0^{(2)}$ is necessarily negative

(d) $E_0^{(0)} + E_0^{(1)}$ is an upper bound to the exact ground state energy

106. Difference between activation energies of the reverse and forward steps of a reversible reaction is 9.212RT. If the pre-exponential factor of the forward reaction is double that of the reverse reaction at the same temperature, the equilibrium constant for the reaction at that temperature will be (ln10 = 2.303)

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

107. For an enzyme-substrate reaction,

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES; \qquad ES \xrightarrow{k_2} E + P,$$

the slope and the intercept of the plot between $\frac{1}{r}$ and $\frac{1}{[S]}$ are $10^{-2}\ s$ and $10^{2}\ M^{-1}s$, respectively. If $E_0 = 10^{-6}\ M$ and $\frac{k_{-1}}{k_2} = 1000$, the value of k_1 will be close to (in units of $M^{-1}s^{-1}$) [r is the rate of the reaction and E_0 is the initial concentration of the enzyme)

(a) 1×10^{11} (b) 1×10^{4} (c) 1×10^{8} (d) 1×10^{6}

108. Translational partition function of a D_2 molecule confined in a 100 cm^3 vessel at 25ºC is ($h = 6.626\times10^{-34}$ J.s, $k = 1.381\times10^{-23}$ JK^{-1})

(a) 3.8×10^{22} (b) 5.8×10^{24} (c) 7.8×10^{26} (d) 9.8×10^{28}

109. The volume (cm^3) of CO adsorbed on charcoal (273 K) at two different pressures is given below

$P(kPa)$	40	80
$V(cm^3)$	25	40

Assuming Langmuir isotherm, the maximum possible volume (cm^3)CO that can be adsorbed is
(a) 50 (b) 100 (c) 150 (d) 200

110. The number of lines in EPR spectrum of CD_3 ($I_D = 1$) is
(a) 3 (b) 5 (c) 7 (d) 9

111. A symmetric top molecule, among the following, is
(a) ethylene (b) allene (c) butatriene (d) hexatriene

112. The allowed electronic transition in fluorine molecule is
(a) $\Sigma_g^+ \rightarrow \Sigma_g^+$ (b) $\Sigma_g^+ \rightarrow \Sigma_g^-$ (c) $\Sigma_g^+ \rightarrow \Pi_u$ (d) $\Sigma_g^+ \rightarrow \Delta_u$

113. Assuming harmonic approximation, the energy change for the reaction $HCl + D_2 \rightarrow DCl + HD$ in cm^{-1} is (the vibrational frequency data in cm^{-1} is given in the table below)

HCl	D_2	DCl	HD
2885	2990	1990	3627

(a) –258 (b) +258 (c) –129 (d) +129

114. The transition moment integral for rotational transition between J = 1; $M_J = 0$ and J = 2; $M_J = 0$ states for a diatomic molecule along the z-axis is proportional to

(a) $\int_0^{\pi} \cos^2\theta\left(3\cos^2\theta - 1\right)d\theta$ (b) $\int_0^{\pi} \cos^2\theta\left(3\cos^2\theta - 1\right)\sin\theta d\theta$

(c) $\int_0^{\pi} \cos\theta\left(3\cos^2\theta - 1\right)\sin\theta d\theta$ (d) $\int_0^{\pi} \cos\theta\left(3\cos^2\theta - 1\right)\sin^2 d\theta$

115. One of the correct normalized sp^2 hybrid orbitals is

(a) $\frac{1}{3}\Phi_{2s} + \frac{1}{3}\Phi_{2p_x} + \frac{1}{3}\Phi_{2p_y}$ (b) $\frac{1}{2}\Phi_{2s} + \frac{\sqrt{3}}{\sqrt{8}}\Phi_{2p_x} + \frac{\sqrt{3}}{\sqrt{8}}\Phi_{2p_y}$

(c) $\frac{1}{\sqrt{3}}\Phi_{2s} + \frac{\sqrt{2}}{\sqrt{3}}\Phi_{2p_x}$ (d) $\frac{1}{3}\Phi_{2s} + \frac{2}{3}\Phi_{2p_x}$

116. At 300K, the thermal expansion coefficient and the isothermal compressiblity of liquid water are $2\times10^4\ K^{-1}$ and $5\times10^{-5}\ bar^{-1}$, respectively. $\left(\frac{\partial U}{\partial V}\right)_T$ (in kbar) for water at 320 K and 1 bar will be
(a) 2.4 (b) 1.2 (c) 0.6 (d) 12.0

117. In the phase diagram of water, the solid-liquid boundary has a negative slope. The reason for this unusual behaviour can be traced to decrease in
(a) density of the system on melting (b) volume of the system on the melting
(c) entropy of the system on melting (d) enthalpy of the system on melting

118. The standard cell potential of cell,

$Pt\,|\,H_2(g)\,|\,HBr(aq)\,|\,AgBr(s)\,|\,Ag(s)$, was measured over a range of temperatures and the data was fitted as $E^0(volt) = 0.01 - 1\times10^{-4}(T-298) - 2\times10^{-6}(T-298)^2$.

The standard reaction entropy (JK^{-1} mol^{-1}) and enthalpy ($kJmol^{-1}$) at 298K are

(a) –9.65 and –3.84 (b) –3.84 and –9.65

(c) –18.3 and –7.68 (d) –7.68 and –18.3

119. The (002) plane of an elemental FCC crystal diffracts X-rays $(\lambda = 0.154nm)$ at Bragg angle 90º. The density of the crystal is 4×10^4 kg m^{-3}. The atomic weight of the elemental solid is

(a) 22 (b) 44 (c) 88 (d) 66

120. A solution of Fe^{3+} is titrated potentiometrically using Ce^{3+} solution at 25ºC. The emf (in V) of the redox system thus formed when, (i) 50 % of Fe^{3+} and (ii) 80% of Fe^{3+} are titrated, would respectively be

(Given : $E^0_{Fe^{3+}|Fe^{2+}} = 0.77V$, $\log_{10} 2 = 0.301$)

(a) 0.734 and 0.77 (b) 0.77 and 0.385 (c) 0.77 and 0.734 (d) 0.385 and 0.37

❍❍❍