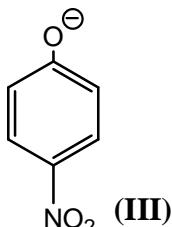
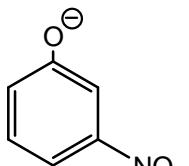
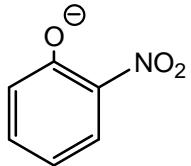


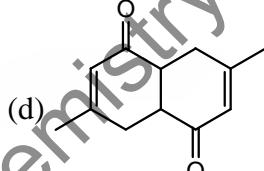
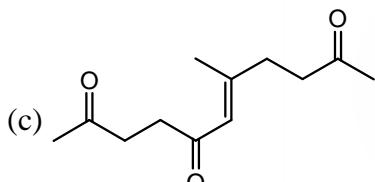
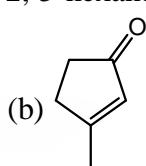
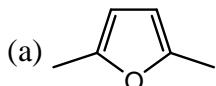
Part-B

21. The correct order of basicity for the following anions is

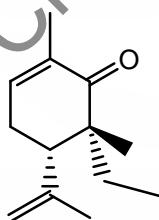


(a) II > III > I (b) I > II > III (c) II > I > III (d) III > II > I

22. The major product formed in the reaction of 2, 5-hexanedione with P_2O_5 is

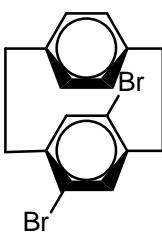


23. The absolute configuration of the two stereogenic (chiral) centres in the following molecule is



(a) 5R, 6R (b) 5R, 6S (c) 5S, 6R (d) 5S, 6S

24. The correct statement about the following molecule is



(a) Molecular is chiral and possesses a chiral plane
(b) Molecule is chiral and possesses a chiral axis.
(c) Molecule is achiral as it possesses a plane of symmetry.
(d) Molecule is achiral as it possesses a centre of symmetry.

25. Consider the following statements about cis- and trans-decalins

(A) cis-isomer is more stable than trans-isomer
(B) trans-isomer is more stable than cis-isomer
(C) trans-isomer undergoes ring-flip
(D) cis-isomer undergoes ring-flip

The correct statements among the above are

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

26. In bis(dimethylglyoximato)nickel(II), the number of Ni–N, Ni–O and intramolecular hydrogen bond(s), respectively are
 (a) 4, 0 and 2 (b) 2, 2 and 2 (c) 2, 2 and 0 (d) 4, 0 and 1

27. Among the following species, (A) Ni(II) as dimethylglyoximate, (B) Al(III) as oximate, (C) Ag(I) as chloride, those that precipitate with the urea hydrolysis method are
 (a) A, B and C (b) A and B (c) A and C (d) B and C

28. If an enzyme fixes N₂ in plants by evolving H₂, the number of electrons and protons associated with that, respectively are
 (a) 6 and 6 (b) 8 and 8 (c) 6 and 8 (d) 8 and 6

29. The particles postulated to always accompany the positron emission among
 (A) neutrino, (B) anti-neutrino, (C) electron,
 are
 (a) A, B and C (b) A and B (c) A and C (d) B and C

30. Toxicity of cadmium and mercury in the body is being reversed by proteins, mainly using the amino acid residue,
 (a) Glycine (b) Leucine (c) Lysine (d) Cysteine

31. NiBr₂ reacts with (Et)(Ph₂)P at -78°C in CS₂ to give red compound 'A', which upon standing at room temperature turns green to give compound, 'B' of the same formula. The measured magnetic moments of 'A' and 'B' are 0.0 and 3.2 BM, respectively. The geometries of 'A' and 'B' are
 (a) square planar and tetrahedral (b) tetrahedral and square planar
 (c) square planar and octahedral (d) tetrahedral and octahedral

32. The correct non-linear and iso-structural pair is
 (a) SCl₂ and I₃⁻ (b) SCl₂ and I₃⁺ (c) SCl₂ and ClF₂⁻ (d) I₃⁺ and ClF₂⁻

33. Ozone present in upper atmosphere protects people on the earth
 (a) due to its diamagnetic nature
 (b) due to its blue colour
 (c) due to absorption of radiation of wavelength at 255nm
 (d) by destroying chlorofluoro carbons

34. If L is a neutral monodentate ligand, the species, [AgL₄]²⁺, [AgL₆]²⁺ and [AgL₄]³⁺, respectively are
 (a) paramagnetic, paramagnetic and dimagnetic
 (d) paramagnetic, diamagnetic and diamagnetic

35. Chromite ore on fusion with sodium carbonate gives
 (a) Na₂CrO₄ and Fe₂O₃ (b) Na₂Cr₂O₇ and Fe₂O₃
 (c) Cr₂(CO₃)₃ and Fe(OH)₃ (d) Na₂CrO₄ and Fe₂(CO₃)₃

36. The ligand(s) that is (are) fluxional in $\left[(\eta^5 - C_5H_5)(\eta^1 - C_5H_5)Fe(CO)_2 \right]$ in the temperature range 221–298K, is (are)
 (a) $\eta^5 - C_5H_5$ (b) $\eta^1 - C_5H_5$ (c) $\eta^5 - C_5H_5$ and CO (d) $\eta^1 - C_5H_5$ and CO

37. $[CoL_6]^3$ is red in colour whereas $[CoL'_6]^{3+}$ is green. L and L' respectively corresponds to,
 (a) NH₃ and H₂O (b) NH₃ and 1, 10-phenanthroline
 (c) NH₃ and 1, 10-phenanthroline (d) H₂O and NH₃

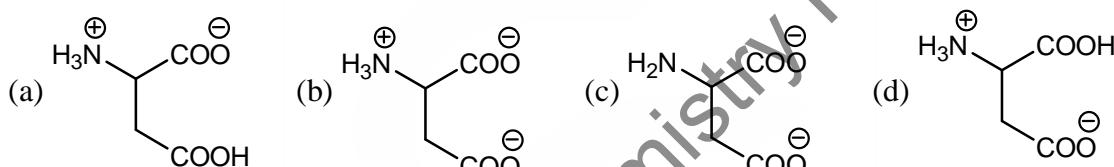
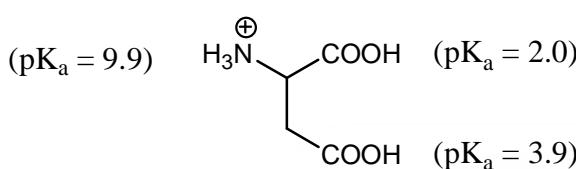
38. The oxidation state of Ni and the number of metal-metal bonds in $[Ni_2(CO)_6]^{2-}$ that are consistent with the 18 electron rule are
 (a) Ni(-II), 1 bond (b) Ni(IV), 2 bonds (c) Ni(-I), 1 bond (d) Ni(IV), 3 bonds

39. Structures of SbPh_5 and PPh_5 respectively are
 (a) trigonal bipyramidal, square pyramidal
 (b) square pyramidal, trigonal bipyramidal
 (c) trigonal bipyramidal, trigonal bipyramidal
 (d) square pyramidal, square pyramidal

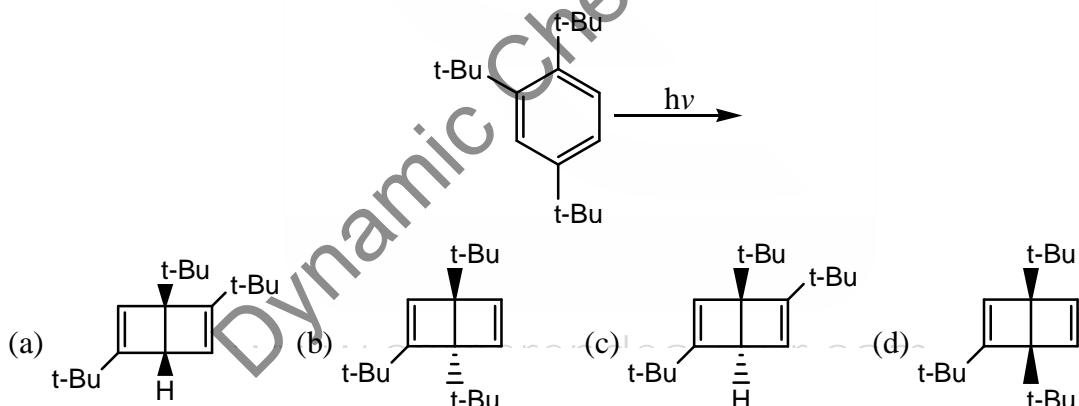
40. The typical electronic configurations of the transition metal centre for oxidative addition
 (a) d^0 and d^8 (b) d^6 and d^8 (c) d^8 and d^{10} (d) d^5 and d^{10}

41. Gelatin added during the polarographic measurement carried out using dropping mercury electrode
 (a) reduces streaming motion of Hg drop
 (b) decreases viscosity of the solution
 (c) eliminates migrating current
 (d) prevents oxidation of Hg

42. The pK_a values of the following salt of aspartic acid are indicated below. The predominant species that would exist at $\text{pH} = 5$ is

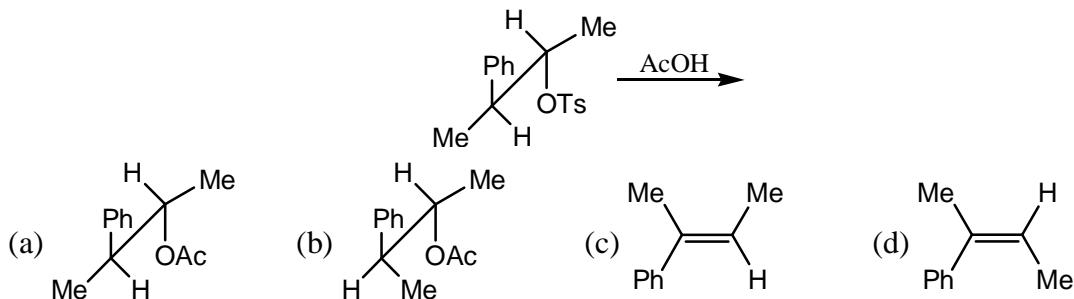


43. The major product formed in the following photochemical reaction is

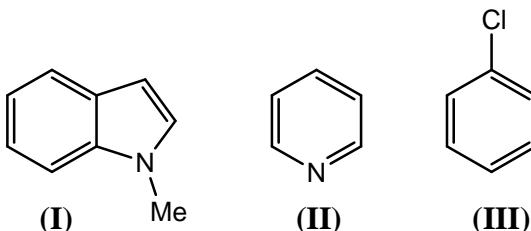


44. The pair of solvents in which PCl_5 does NOT ionize, is
 (a) $\text{CH}_3\text{CN}, \text{CH}_3\text{NO}_2$ (b) $\text{CH}_3\text{CN}, \text{CCl}_4$
 (c) $\text{C}_6\text{H}_6, \text{CCl}_4$ (d) $\text{CH}_3\text{CN}, \text{C}_6\text{H}_6$

45. The major product formed in the following reaction is



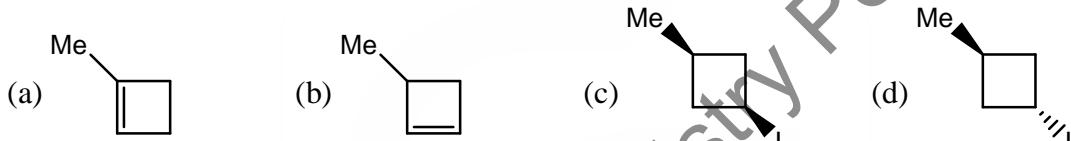
46. The correct order for the rates of electrophilic aromatic substitution of the following compound is



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

47. The commutator of the kinetic energy operator, \hat{T}_x and the momentum operator, \hat{p}_x for the one-dimensional case is

48. The major product formed in the reaction of trans-1-bromo-3-methylcyclobutane with sodium iodide in DMF is



49. When Si is doped with a Group V element,

- (a) donor levels are created close to the valence band
- (b) donor levels are created close to the conduction band
- (c) acceptor levels are created close to the valence band
- (d) acceptor levels are created close to the conduction band

50. The symmetry point group of propyne is

(a) C_3 (b) C_{3v} (c) D_3 (d) D_{3d}

51. For a first order reaction $A \rightarrow \text{products}$, the plot of $\ln\left(\frac{[A]_t}{[A]_0}\right)$ vs time, where $[A]_0$ and $[A]_t$ refer

to concentration at time $t = 0$ and t respectively, is

(a) a straight line with a positive slope passing through origin
(b) a straight line with a negative slope passing through origin.
(c) an exponential curve asymptotic to the time axis

(d) a curve asymptotic to the $\ln\left(\frac{[A]_t}{[A]_0}\right)$ axis.

In radical chain polymerization, the quantity given by the rate of monomer depletion, divided by

(c) propagation rate constant (d) polymerization time

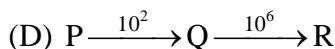
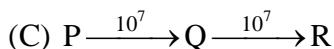
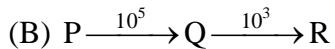
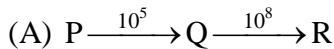
53. Number of rotational symmetry axes for triclinic crystal system is

54. Generally, hydrophobic colloids are flocculated efficiently by ions of opposite type and high charge number. This is consistent with the

(a) peptization principle (b) krafft theory
(c) Hofmeister effect (d) Langmuir monolayer

(c) Hardy-Schulze rule (d) Langmuir adsorption mechanism

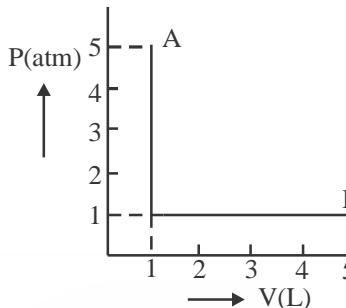
55. Examine the following first order consecutive reactions. The rate constant (in s^{-1} units) for each step is given above the arrow mark



Steady-state approximation can be applied to

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

56. The figure below represents the path followed by a gas during expansion from A \rightarrow B. The work done is (L atm)



(a) 0

(b) 9

(c) 5

(d) 4

57. An aqueous solution of an optically pure compound of concentration 100 mg in 1 mL of water and measured in a quartz tube of 5 cm length was found to be -3° . The specific rotation is
 (a) -30° (b) -60° (c) -6° (d) $+6^\circ$

58. Two phases (α and β) of a species are in equilibrium. The correct relations observed among the variables, T, p and μ are

(a) $T_\alpha = T_\beta$, $p_\alpha \neq p_\beta$, $\mu_\alpha = \mu_\beta$

(b) $T_\alpha \neq T_\beta$, $p_\alpha = p_\beta$, $\mu_\alpha = \mu_\beta$

(c) $T_\alpha = T_\beta$, $p_\alpha = p_\beta$, $\mu_\alpha = \mu_\beta$

(d) $T_\alpha = T_\beta$, $p_\alpha = p_\beta$, $\mu_\alpha \neq \mu_\beta$

59. The number of configurations in the most probable state, according to Boltzmann formula, is

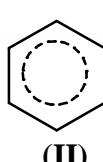
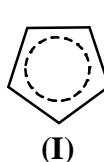
(a) e^{S/k_B}

(b) e^{-S/k_B}

(c) $e^{-E/k_B T}$

(d) $e^{-\Delta G/k_B T}$

60. The correct match of the ^1H NMR chemical shifts (δ) of the following species/compounds is



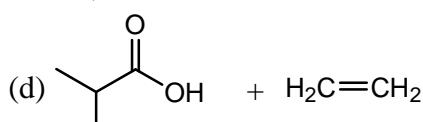
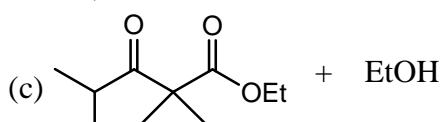
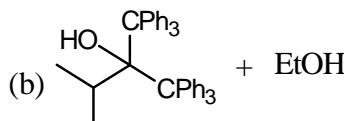
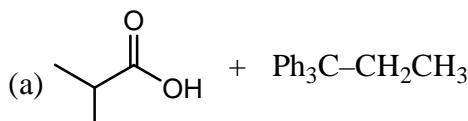
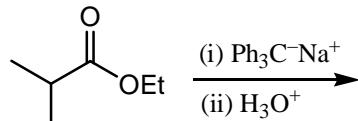
(a) I : 5.4; II : 7.2; III : 9.2

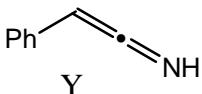
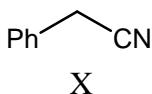
(b) I : 9.2; II : 7.2; III : 5.4

(c) I : 9.2; II : 5.4; III : 7.2

(d) I : 7.2; II : 9.2; III : 5.4

61. The major products formed in the following are

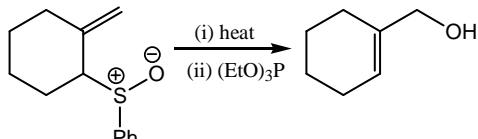




(A) X and Y are resonance structures (B) X and Y are tautomers
(C) Y is more basic than X (D) X is more basic than Y

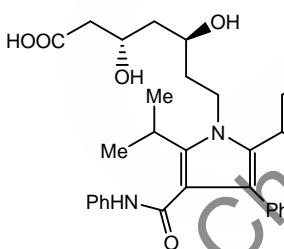
The correct statement(s) among the above is/are

64. The correct statement(s) among the above is/are
(a) A and C (b) C (c) B and D (d) B and C
Pericyclic reaction involved in one of the steps of the following reaction sequence is



(a) [1, 3] sigmatropic shift (b) [3, 3] sigmatropic shift
(c) [1, 5] sigmatropic shift (d) [2, 3] sigmatropic shift

65. Atorvastatin (structure given below) is a



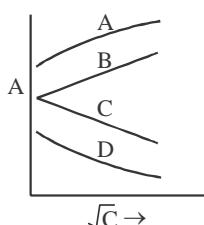
(a) cholesterol lowering drug (b) blood sugar lowering drug
(c) anti-plasmodial drug (d) anti-HIV drug

66. The maximum bond order obtained from the molecular orbitals of a transition metal dimer,

67. The term symbol that is NOT allowed for the np^2 configuration is
(a) 1D (b) 3P (c) 1S (d) 3D

69. If temperature is doubled and the mass of the gaseous molecule is halved, the rms speed of the molecular will change by a factor of

70. In the graph below, the correct option, according to Kohlrausch law, is



- (a) A is a weak electrolyte and B is a strong electrolyte
- (b) A is a strong electrolyte and B is a weak electrolyte
- (c) C is a strong electrolyte and D is a weak electrolyte
- (d) C is weak electrolyte and D is a strong electrolyte

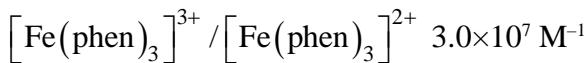
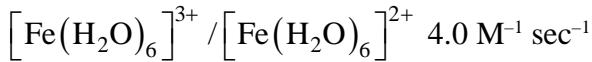
PART-C

71. Reaction of $[\text{Ru}(\text{NH}_3)_5(\text{isonicotinamide})]^{3+}$ with $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ occurs by inner sphere mechanism and rate of the reaction is determined by dissociation of the successor complex. It is due to the

- Inert ruthenium bridged to inert chromium centre
- Inert ruthenium bridged to labile chromium centre
- Labile ruthenium bridged to inert chromium centre
- Labile ruthenium bridged to labile chromium centre

72. Consider the second order rate constants for the following outer-sphere electron transfer reactions:

72. Consider the second order rate constants for the following outer-sphere electron transfer reactions:



(phen = 1, 10-phenanthroline)

The enhanced rate constant for the second reaction is due to the fact that

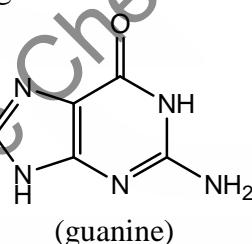
The enhanced rate constant for the second reaction is due to the fact that

- The 'phen' is a π -acceptor ligand that allows mixing of electron donor and acceptor orbitals that enhances the rate of electron transfer
- The 'phen' is a π -donor ligand that enhances the rate of electron transfer
- The 'phen' forms charge transfer complex with iron and facilitates the electron transfer
- The 'phen' forms kinetically labile complex with iron and facilitates the electron transfer.

73. The compound $[\text{Re}_2(\text{Me}_2\text{PPh})_4\text{Cl}_4]$ (M) having a configuration of $\sigma^2\pi^4\delta^2\delta^{*2}$ can be oxidized to M^+ and M^{2+} . The formal metal-metal order in M, M^+ and M^{2+} respectively, are

- 3.0, 3.5 and 4.0
- 3.5, 4.0 and 3.0
- 4.0, 3.5 and 3.0
- 3.0, 4.0 and 3.5

74. In low chloride ion concentration, the anticancer drug cis-platin hydrolyses to give a diaqua complex and this binds to DNA via adjacent guanine



The coordinating atom of guanine to Pt(II) is

75. The ^{19}F NMR spectrum of ClF_3 shows
 (a) doublet and triplet for a T-shaped structure
 (b) singlet for a trigonal planar structure
 (c) singlet for a trigonal pyramidal structure
 (d) doublet and singlet for a T-shaped structure

76. The low temperature (-98°C) ^{19}F NMR spectrum of SF_4 shows doublet of triplets. It is consistent with the point group symmetry.
 (a) $\text{C}_{3\text{v}}$ (b) $\text{C}_{4\text{v}}$ (c) T_d (d) $\text{C}_{2\text{v}}$

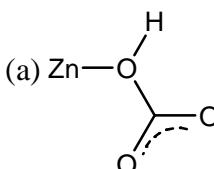
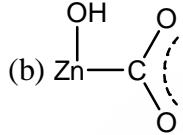
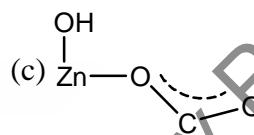
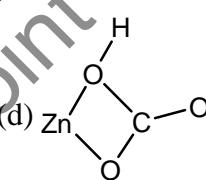
77. Amongst organolithium (A), Grignard (B) and organoaluminium (C) compounds, those react with SiCl_4 to give compound containing Si-C bond are
 (a) A and B (b) B and C (c) A and C (d) A, B and C

87. The correct order of decreasing electronegativity of the following atoms is,
 (a) As > Al > Ca > S (b) S > As > Al > Ca (c) Al > Ca > S > As (d) S > Ca > As > Al

88. A 1 : 2 mixture of $\text{Me}_2\text{NCH}_2\text{CH}_2\text{CH}_2\text{PPh}_2$ and KSCN with $\text{K}_2[\text{PdCl}_4]$ gives a square planar complex
 A. Identify the correct pairs of donor atoms trans to each other in complex A from the following combinations.
 (a) P, N (b) N, S (c) P, S (d) N, N

89. For a low energy nuclear reaction, $^{24}\text{Mg}(\text{d}, \alpha)^{22}\text{Na}$, the correct statements from the following are
 (A) Kinetic energy of d particle is not fully available for exciting ^{24}Mg .
 (B) Total number of protons and neutrons is conserved
 (C) Q value of nuclear reaction is much higher in magnitude relative to heat of chemical reaction
 (D) Threshold energy is $\leq Q$ value.
 (a) A, B and C (b) A, B and D (c) B, C and D (d) A, C and D

90. At pH 7, the zinc(II) ion in carbonic anhydrase reacts with CO_2 to give

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

91. Molybdoenzymes can both oxidize as well as reduce the substrates, because
 (a) Mo(VI) is more stable than Mo(IV)
 (b) Mo(IV) can transfer oxygen atom to the substrate and Mo(VI) can abstract oxygen atom from the substrate
 (c) Conversion of Mo(VI) to Mo(IV) is not favoured
 (d) Mo(VI) can transfer oxygen atom to the substrate and Mo(IV) can abstract oxygen atom from the substrate.

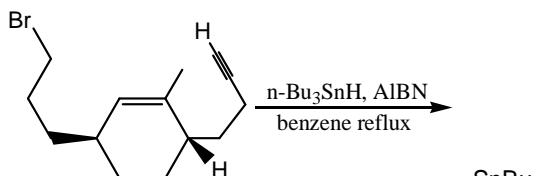
92. A comparison of the valence electron configuration of the elements, Sm and Eu suggests that
 (a) Sm is a better one electron reductant than Eu
 (b) Sm is a better one electron oxidant than Eu
 (c) Facile oxidation state is +2 for both the elements
 (d) Both of these display similar redox behaviour.

93. The cooperative binding of O_2 in hemoglobin is due to
 (a) a decrease in size of iron followed by changes in the protein conformation
 (b) an increase in size of iron followed by changes in the protein conformation
 (c) a decrease in size of iron that is NOT accompanied by the protein conformational changes
 (d) an increase in size of iron that is NOT accompanied by the protein conformational changes

94. Amongst the following which is not isolobal pairs
 (a) $\text{Mn}(\text{CO})_5$, CH_3 (b) $\text{Fe}(\text{CO})_4$, O (c) $\text{Co}(\text{CO})_3$, R_2Si (d) $\text{Mn}(\text{CO})_5$, RS

95. The correct order of the size of S, S^{2-} , S^{2+} and S^{4+} species is,
 (a) $\text{S} > \text{S}^{2+} > \text{S}^{4+} > \text{S}^{2-}$ (b) $\text{S}^{2+} > \text{S}^{4+} > \text{S}^{2-} > \text{S}$
 (c) $\text{S}^{2-} > \text{S} > \text{S}^{2+} > \text{S}^{4+}$ (d) $\text{S}^{4+} > \text{S}^{2-} > \text{S} > \text{S}^{2+}$

96. The major product formed in the following reaction is



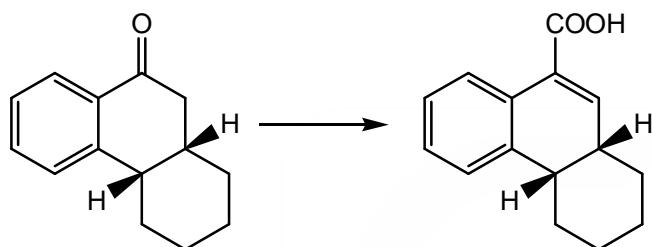
(a)

(b)

(c)

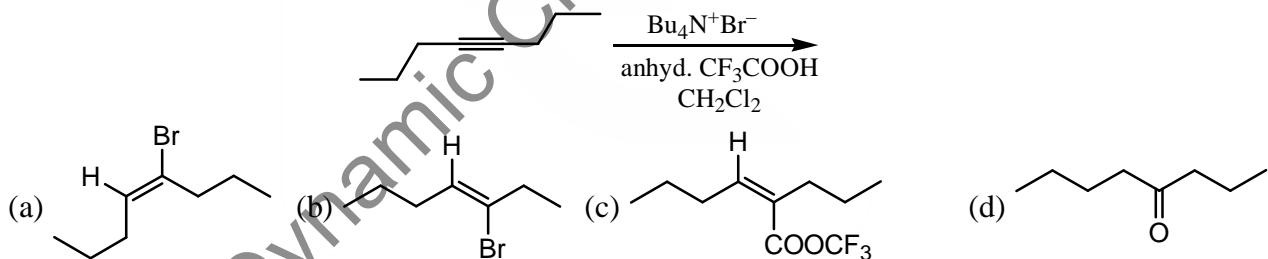
(d)

97. The correct combination of reagents to effect the following conversion is

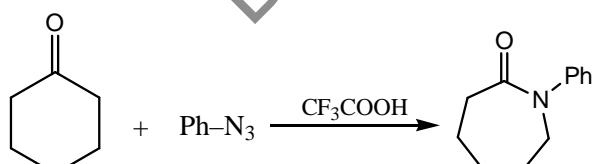


(a) (i) $\text{Ph}_3\text{P}^+\text{CH}_2\text{OMeCl}^-$, BuLi , (ii) H_3O^+ , Jones' reagent
 (b) (i) $\text{H}_2\text{N}^-\text{NHTs}$; (ii) BuLi (2 equiv); (iii) DMF
 (c) (i) $\text{H}_2\text{N}^-\text{NHTs}$; (ii) BuLi (2 equiv); (iii) CO
 (d) (i) $\text{ClCH}_2\text{CO}_2\text{Et}$, LDA ; (ii) BF_3OEt_2 ; (iii) DMSO , $(\text{COCl})_2$, Et_3N , -78°C to rt.

98. The major product formed in the following reaction is



99. Consider the following reaction,



The appropriate intermediate involved in this reaction is

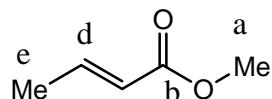
(a)

(b)

(c)

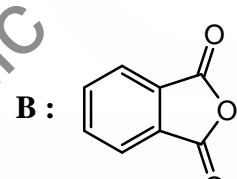
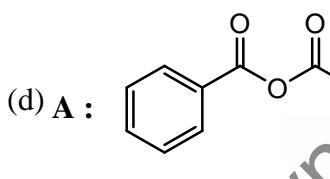
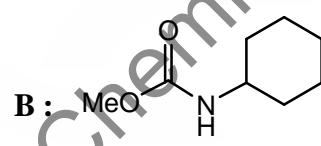
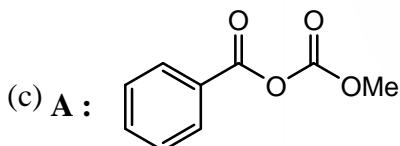
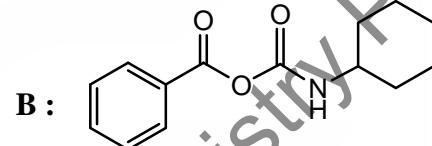
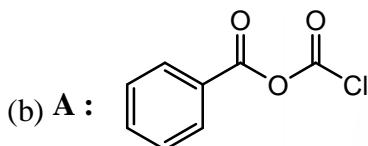
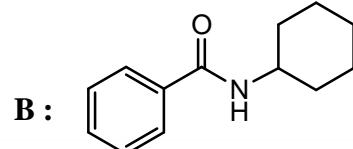
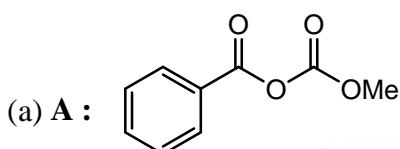
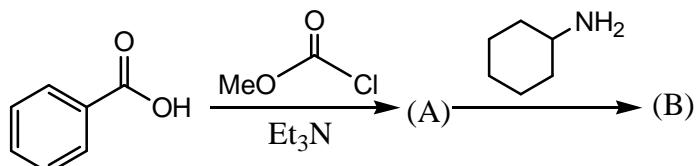
(d)

100. The correct ^{13}C NMR chemical (δ) shift values of carbons labeled a-e in the following ester are



(a) a : 19; b : 143; c : 167; d : 125; e : 52 (b) a : 52; b : 143; c : 167; d : 125; e : 19
 (c) a : 52; b : 167; c : 143; d : 125; e : 19 (d) a : 52; b : 167; c : 125; d : 143; e : 19

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

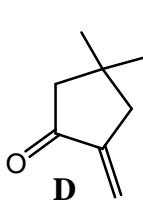
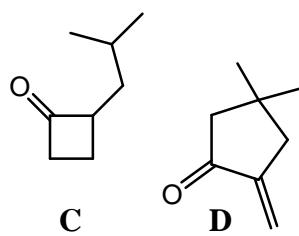
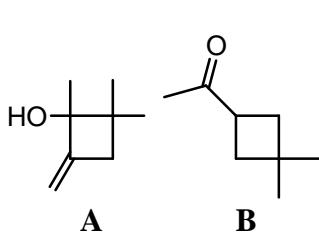
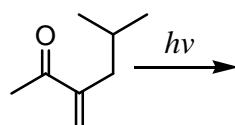


A. Four molecules of acetyl CoA B. Three molecules of ATP
 C. Two molecules of NADPH D. Two molecules of lipoic acid

The correct options among these are

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

103. Amongst the following, the major products formed in the following photochemical reactions are



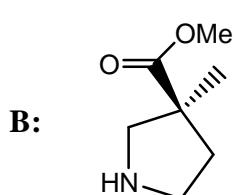
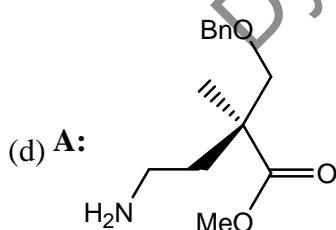
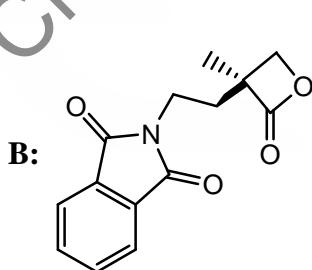
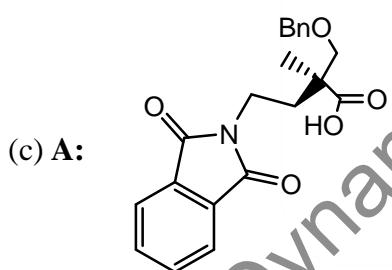
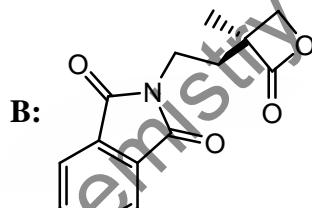
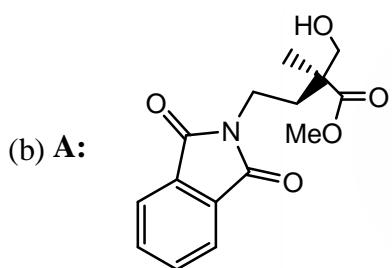
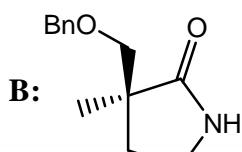
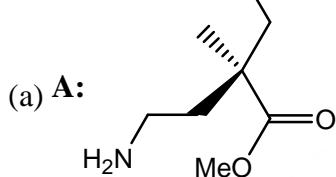
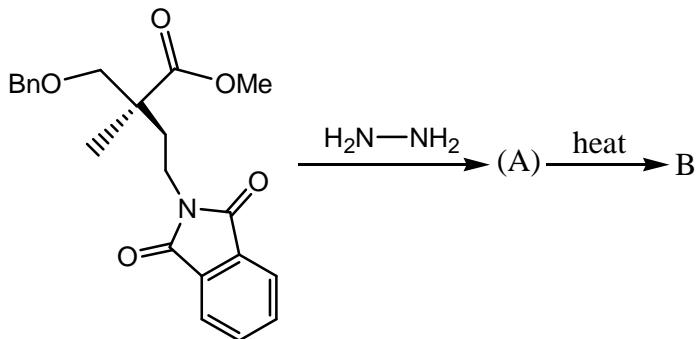
(a) A and C

(b) B and C

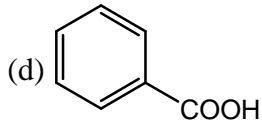
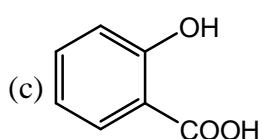
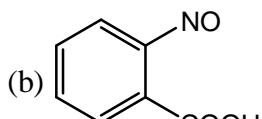
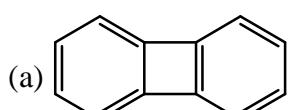
(c) A and D

(d) A and B

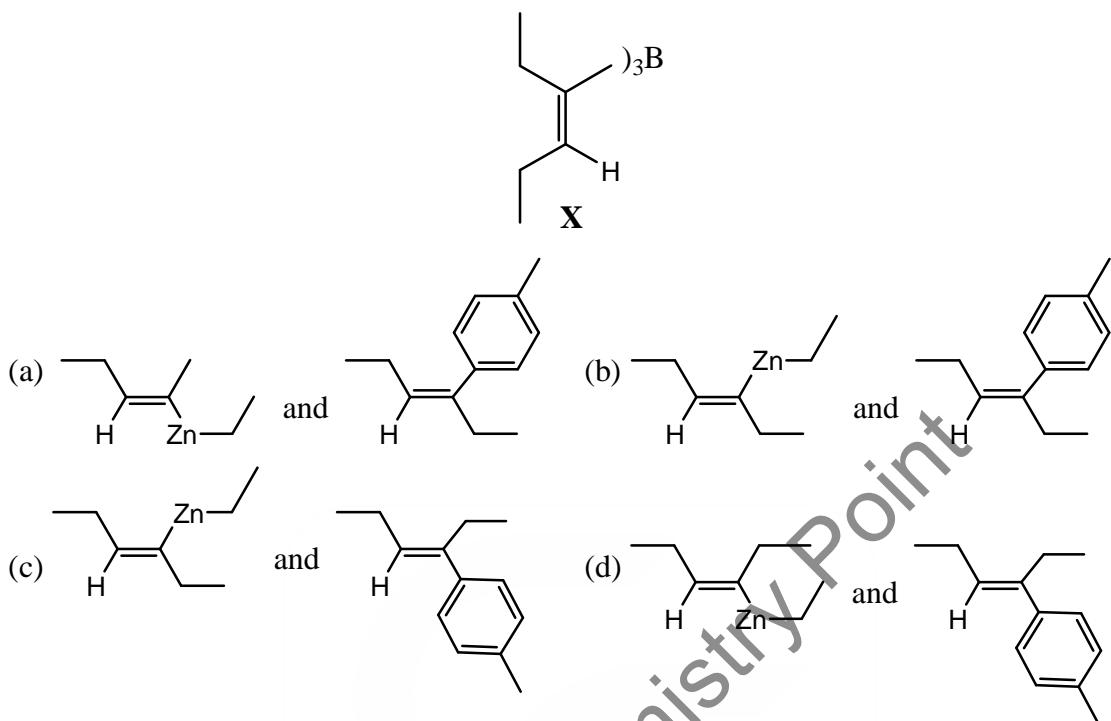
104. The products A and B in the following reaction sequence are



105. Anthranilic acid, on treatment with iso-amyl nitrite furnishes a product which displays a strong peak at 76 (m/e) in its mass spectrum. The structure of the product is



106. The organoborane X, when reacted with Et_2Zn followed by p-iodotoluene in the presence of catalytic amount of $\text{Pd}(\text{PPh}_3)_4$ furnishes a tri-substituted alkene. The intermediate and the product of the reaction, respectively, are

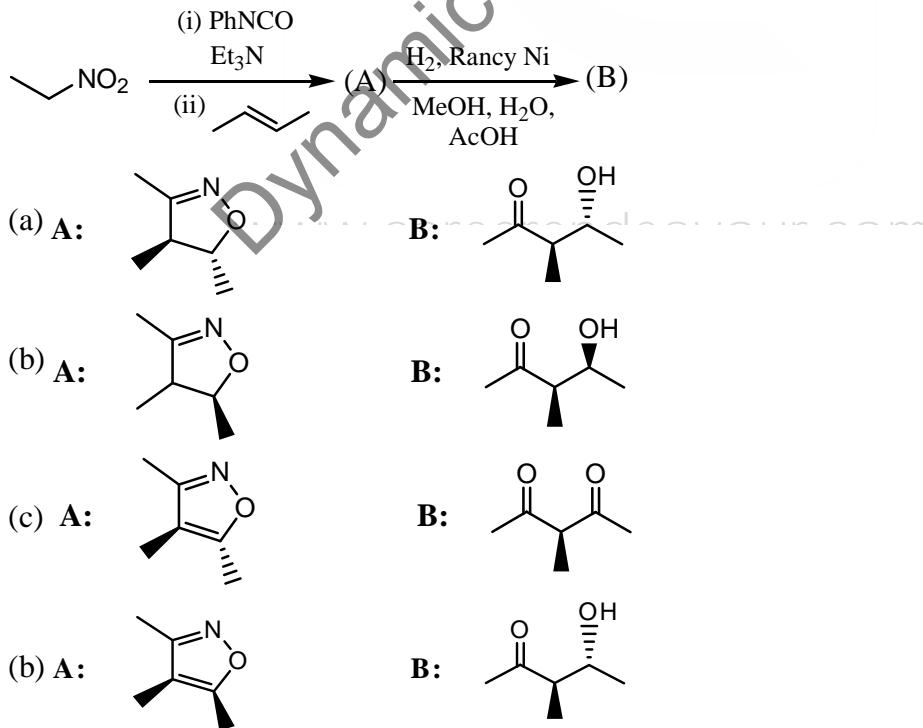


107. Using Boltzmann distribution, the probability of an oscillator occupying the first three levels ($n = 0, 1$ and 2) is found to be $p_0 = 0.633$, $p_1 = 0.233$ and $p_2 = 0.086$.

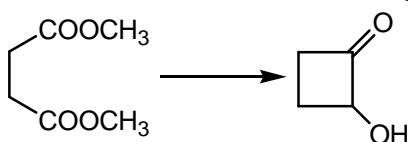
The probability of finding an oscillator in energy levels in $n \geq 3$ is

(a) 0.032 (b) 0.048 (c) 0.952 (d) 1.000

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



109. The correct combination of reagents required to effect the following conversion is

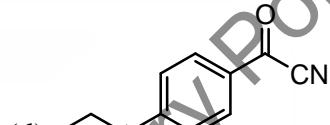
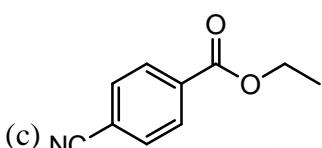
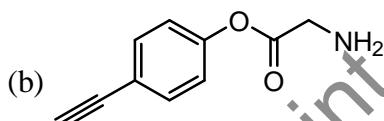
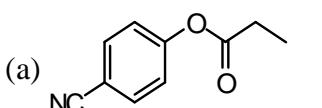


- (a) (i) Na, xylene, Me_3SiCl , heat; (ii) H_3O^+
- (b) (i) Na, xylene, heat; (ii) H_2O_2 , NaOH
- (c) (i) NaOEt , EtOH; (ii) Na, xylene, heat
- (d) (i) TiCl_3 , Zn–Cu, Me_3SiCl , heat; (ii) H_3O^+

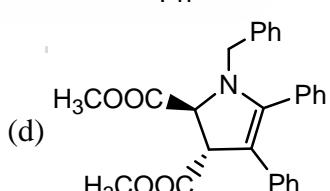
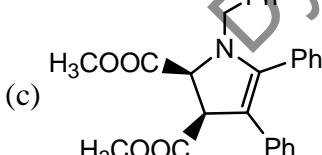
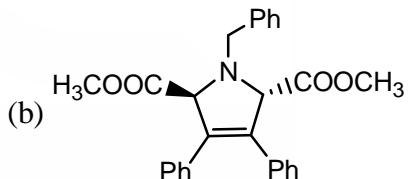
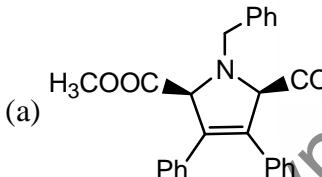
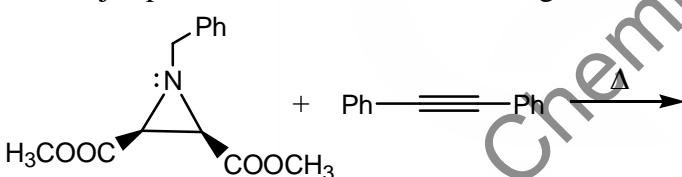
110. An organic compound gives following spectral data:

IR : 2210, 1724 cm^{-1} , ^1H NMR : δ 1.4 (t, $J = 7.1$ Hz, 3H), 4.4 (q, $J = 7.1$ Hz, 2H); ^{13}C NMR : δ 16, 62, 118, 119, 125, 127, 168.

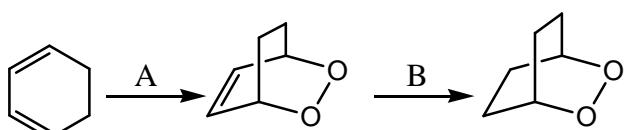
The compound is



111. The major product formed in the following reaction is

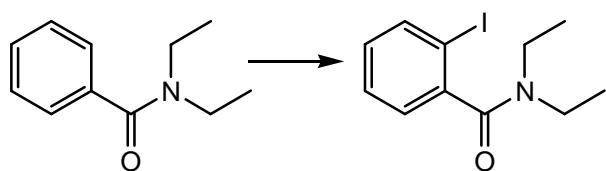


112. The correct combination of reagents for effecting the following sequence of reactions is



- (a) A = O_3/O_2 ; B = $\text{K}^+\text{OOC-N=N-COO}^- \text{K}^+$, AcOH
- (b) A = O_2 , Rose Bengal, hv ; B = $\text{K}^+\text{OOC-N=N-COO}^- \text{K}^+$, AcOH
- (c) A = O_2 , Rose Bengal, hv ; B = H_2 , Pd/C
- (d) A = O_2 , Rose Bengal; Δ ; B = H_2 , Pd/C

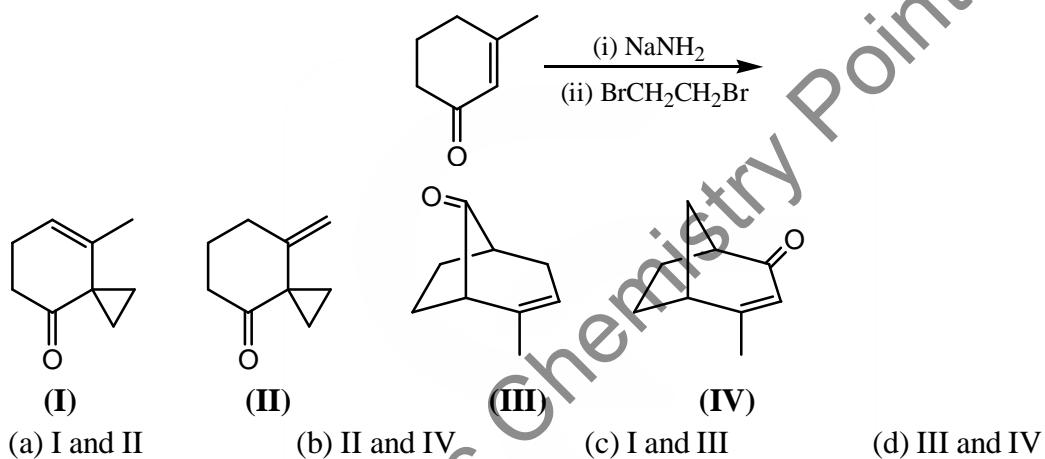
113. The correct combination of reagents required to effect the following conversion is



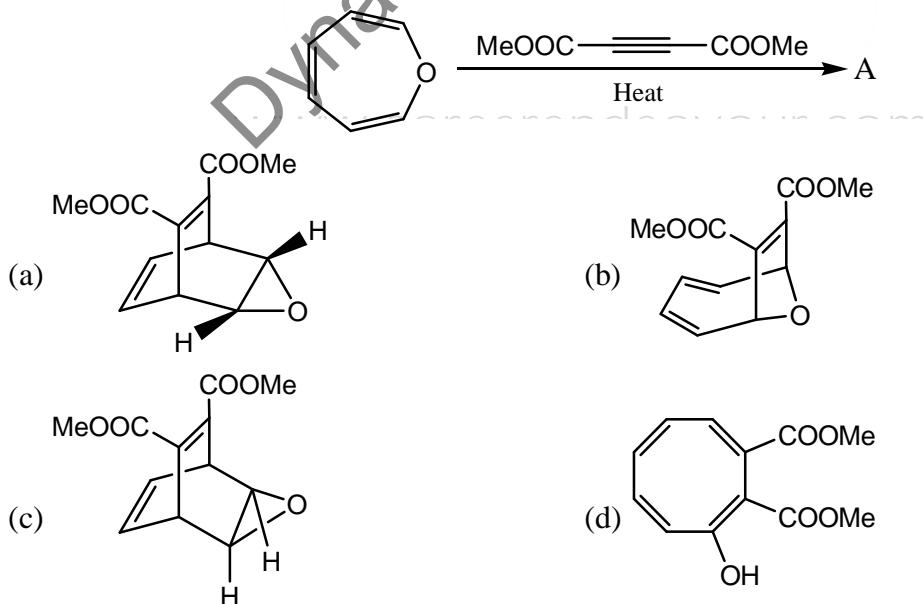
(a) I_2 , HNO_3
 (b) s-BuLi, $-78^\circ C$ followed by KI
 (c) NaOEt followed by ICH_2CH_2I
 (d) s-BuLi, $-78^\circ C$ followed by ICH_2CH_2I

114. Consider a particle confined in a cubic box. The degeneracy of the level, that has an energy twice that of the lowest level, is

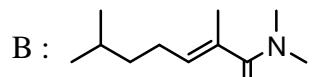
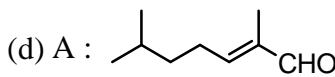
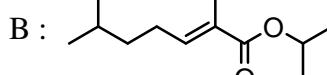
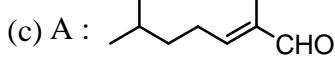
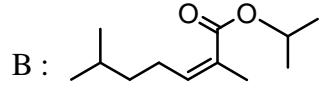
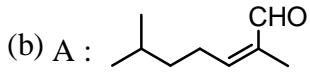
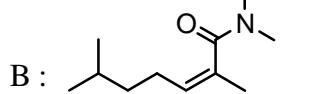
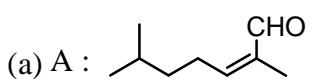
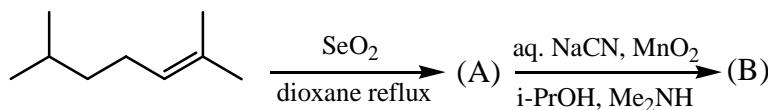
115. Only two products are obtained in the following reaction sequence. The structures of the products from the list I-IV are X



116. The major product A formed in the following reaction is



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



118. The spatial part of the wave function of the atom in its ground state is $1s(1)$ $1s(2)$. The spin part would be

(a) $\alpha(1)\alpha(2)$

(b) $\beta(1)\beta(2)$

(c) $\frac{1}{\sqrt{2}}[\alpha(1)\beta(2)+\beta(1)\alpha(2)]$

(d) $\frac{1}{\sqrt{2}}[\alpha(1)\beta(2)-\beta(1)\alpha(2)]$

119. The number of phases, components and degrees of freedom, when Ar is added to an equilibrium mixture of NO, O₂ and NO₂ in gas phase are, respectively,

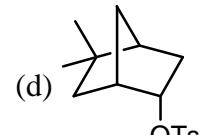
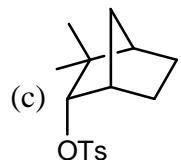
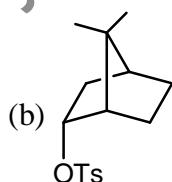
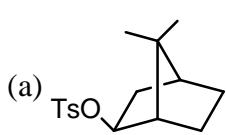
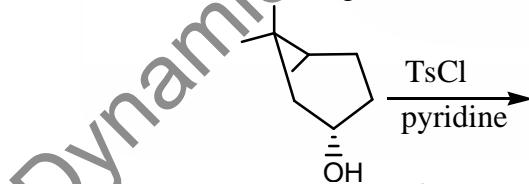
(a) 1, 3, 5

(b) 1, 4, 5

(c) 1, 3, 4

(d) 1, 4, 4

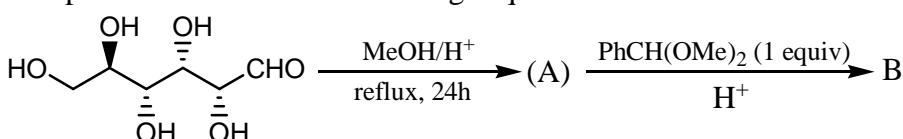
120. The major product formed in the following reaction is

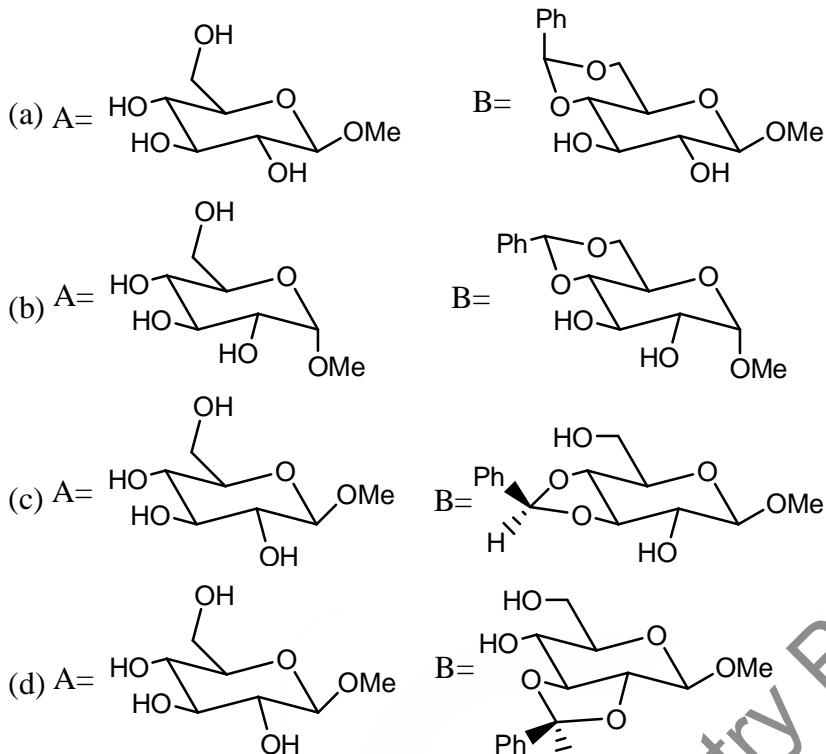


121. A particle in a one dimensional harmonic oscillator in x-direction is perturbed by a potential λx (λ is a number). The first-order correction to the energy of the ground state

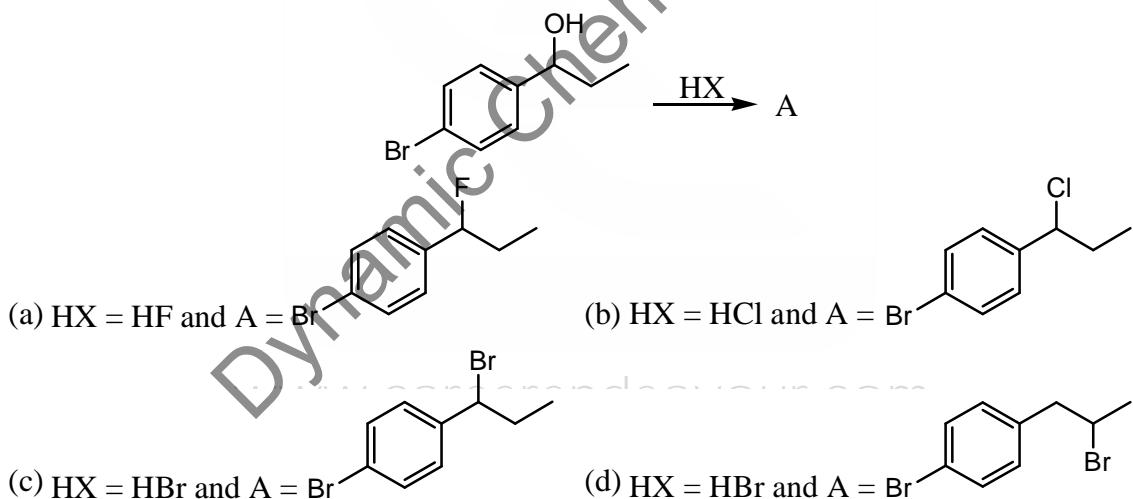
(a) is zero
(b) is negative
(c) is positive
(d) may be negative or positive but NOT zero.

122. The points A and B in the following sequence of reactions are





123. The mass spectrum of the product A, formed in the following reaction, exhibits M, M+2, M + 4 peaks in the ratio of about 1 : 2 : 1. The reagent HX and the product A are



124. Match the following natural products in column A with their structural features in column B

Column A

(I) Colchicine
(II) Strychnine
(III) Quinine
(IV) Ephedrine

Column B

(A) Tetrahydrooxepine
(B) Phenanthrene
(C) Tropolone
(D) Phenylethylamine
(E) Quinoline
(F) Benzofuran

Identify the correct match from the following

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

125. A particle in a one-dimensional box (potential zero between a and infinite outside) has the ground state energy $E_0 = \frac{0.125\hbar^2}{ma^2}$. The expectation value of the above Hamiltonian with $\psi(x) = x(x-a)$ yields an energy E_1 . Using a linear combination of two even functions $x(x-a)$ and $x^2(x-a)^2$, we obtain variational minimum to the ground state energy as E_2 . Which of the following relations holds for E_0 , E_1 and E_2 ?

(a) $E_0 < E_1 < E_2$ (b) $E_0 < E_2 < E_1$ (c) $E_1 < E_0 < E_2$ (d) $E_2 < E_0 < E_1$

126. The dissociation constant of a weak acid HX at a given temperature is 2.5×10^{-5} . The pH of 0.01 M NaX at this temperature is

(a) 7.3 (b) 7.7 (c) 8.3 (d) 8.7

127. The ground state energy of hydrogen atom is -13.598 eV. The expectation values of kinetic energy, $\langle T \rangle$ and potential energy, $\langle V \rangle$, in units of eV, are

(a) $\langle T \rangle = 13.598, \langle V \rangle = -27.196$ (b) $\langle T \rangle = -27.196, \langle V \rangle = 13.598$
 (c) $\langle T \rangle = -6.799, \langle V \rangle = -6.799$ (d) $\langle T \rangle = 6.799, \langle V \rangle = -20.397$

128. If $\psi = 0.8 \varphi_A + 0.4 \varphi_B$ is a normalized molecular orbital of a diaotmic molecule AB, constructed from φ_A and φ_B which are also normalized, the overlap between φ_A and φ_B is

(a) 0.11 (b) 0.31 (c) 0.51 (d) 0.71

129. At a given temperature consider

$$\text{Fe}_2\text{O}_3(\text{s}) + 3\text{CO}(\text{g}) \rightleftharpoons 2\text{Fe}(\text{s}) + 3\text{CO}_2(\text{g}); K_1 = 0.05$$

$$2\text{CO}_2(\text{g}) \rightleftharpoons 2\text{CO}(\text{g}) + \text{O}_2(\text{g}); K_2 = 2 \times 10^{-12}$$

The equilibrium constant for the reaction

$$2\text{Fe}_2\text{O}_3(\text{s}) \rightleftharpoons 4\text{Fe}(\text{s}) + 3\text{O}_2$$

(a) 1×10^{-13} (b) 2×10^{-38} (c) 4×10^{-15} (d) 2×10^{-24}

130. In a bomb calorimeter, the combustion of 0.5 g of compound A (molar mass = 50 g mol⁻¹) increased the temperature by 4K. If the heat capacity of the calorimeter along with that of the material is 2.5 kJ K⁻¹, the molar internal energy of combustion, in kJ, is

(a) 1000 (b) -1000 (c) 20 (d) -20

131. The translational, rotational and vibrational partition functions for a molecule are $f_{\text{translation}} \simeq 10^{10} \text{ m}^{-1}$, $f_{\text{rotation}} \simeq f_{\text{vibration}} \simeq 1$, $(k_B T / \hbar) \simeq 10^{13}$ at room temperature, $N_A \simeq 6 \times 10^{23}$. Using the approximate data given above, the frequency factor (A) for a reaction of the type: atom + diatomic molecule \rightarrow non-linear transition state \rightarrow product, according to the conventional transition state theory is

(a) 2×10^3 (b) 6×10^7 (c) 2×10^{12} (d) 6×10^{13}

132. The interplanar spacing of (110) planes in a cubic unit cell with lattice parameter $a = 4.242\text{\AA}$ is
 (a) 5\AA (b) 6\AA (c) 7.35\AA (d) 2.45\AA

133. A compound $A_x B_y$ has a cubic structure with A atoms occupying all corners of the cube as well as all the face centre positions. The B atoms occupy four tetrahedral voids. The values of x and y respectively, are
 (a) 4, 4 (b) 4, 8 (c) 8, 4 (d) 4, 2

134. The number of lines in the ESR spectrum of CD_3 is (the spin of D is 1)
 (a) 1 (b) 3 (c) 4 (d) 7

135. The C = O bond length is 120 pm in CO_2 . The moment of inertia of CO_2 would be close to (masses of C and O are 1.9×10^{-27} kg and 2.5×10^{-27} kg, respectively)
 (a) 1.8×10^{-45} kgm^2 (b) 3.6×10^{-45} kgm^2
 (c) 5.4×10^{-45} kgm^2 (d) 7.2×10^{-45} kgm^2

136. The fluorescence lifetime of a molecule in a solution is 5×10^{-9} s. The sum of all of the non-radiative rate constants (Σk_{nr}) for the decay of excited state is $1.2 \times 10^8 \text{ s}^{-1}$. The fluorescence quantum yield of the molecule is
 (a) 0.1 (b) 0.2 (c) 0.4 (d) 0.6

137. Solutions of three electrolytes have the same ionic strength and different dielectric constants as 4, 25 and 81. The corresponding relative magnitude of Debye-Hückel screening, lengths of the three solutions are
 (a) 4, 25 and 81 (b) 2, 5 and 9 (c) 1/2, 1/5 and 1/9 (d) 1, 1 and 1

138. Simple Hückel molecular orbital theory
 (a) considers electron-electron repulsion explicitly
 (b) distinguishes cis-butadiene and trans-butadiene
 (c) distinguishes cis-butadiene and cyclobutadiene
 (d) has different coulomb integrals for non-equivalent carbons.

139. For the non-dissociative Langmuir type adsorption of a gas on a solid surface at a particular temperature, the fraction of surface coverage is 0.6 at 30 bar. The Langmuir isotherm constant (in bar^{-1} units) at this temperature is
 (a) 0.05 (b) 0.20 (c) 2.0 (d) 5.0

140. For a set of 10 observed data points, the mean is 8 and the variance is 0.04. The 'standard deviation' and the 'coefficient of variation' of the data are, respectively
 (a) 0.005, 0.1% (b) 0.02, 0.2% (c) 0.20, 2.5% (d) 0.32, 1.0%

141. In the Lineweaver-Burk plot of $(\text{initial rate})^{-1}$ vs. $(\text{initial substrate concentration})^{-1}$ for an enzyme catalyzed reaction following Michaelis-Menten mechanism, the y-intercept is $5000 \text{ M}^{-1} \text{ s}$. If the initial enzyme concentration is $1 \times 10^{-9} \text{ M}$, the turnover number is
 (a) 2.5×10^3 (b) 1.0×10^4 (c) 2.5×10^4 (d) 2.0×10^5

142. The $E \otimes E$ direct product in D_3 point group contains the irreducible representations

D_3	E	$2C_3$	$3C_2$
A_1	1	1	-1
A_2	1	1	-1
E_2	2	-1	0

(a) $A_1 + A_2 + E$ (b) $2A_1 + E$ (c) $2A_2 + E$ (d) $2A_1 + 2A_2$

143. The result of the product $C_2(x)C_2(y)$ is
 (a) E (b) σ_{xy} (c) $C_2(z)$ (d) i

144. Given;

- A. $\text{Fe(OH)}_2(s) + 2\text{e}^- \rightarrow \text{Fe}(s) + 2\text{OH}^-(aq); E^0 = -0.877\text{V}$
- B. $\text{Al}^{3+}(aq) + 3\text{e}^- \rightarrow \text{Al}(s); E^0 = -1.66\text{V}$
- C. $\text{AgBr}(aq) + \text{e}^- \rightarrow \text{Ag}(s) + \text{Br}^-(aq); E^0 = 0.071\text{V}$

The overall reaction for the cells in the direction of spontaneous change would be

(a) Cell with A and B : Fe reduced

Cell with A and C : Fe reduced

(b) Cell with A and B : Fe reduced

Cell with A and C : Fe oxidized

(c) Cell with A and B : Fe oxidized

Cell with A and C : Fe oxidized

(d) Cell with A and B : Fe oxidized

Cell with A and C : Fe reduced

145. The reagent A used and the major product B formed in the following reaction sequence are

