PAPER : CSIR-UGC-NET/JRF June 2017

CHEMICAL SCIENCES BOOKLET-[A]

PART-B

21. Which one of the following pairs has two magic numbers for closed nuclear shells ?
(a) 8, 10 (b) 10, 20 (c) 50, 82 (d) 82, 130

22. Identify the correct statement(s) for phosphorimetric measurement from the following :
A. It is done after a time delay when fluorescence, if present becomes negligible
B. Immobilization of analytic increases phosphorescence
C. Phosphorescence decreases in the presence of heavy atoms
(a) A only (b) A and B (c) A and C (d) B and C

23. Choose the isoelectronic pair among the following :
A. $[V(CO)_6]$
B. $[Cu(\eta^5—C_5H_5)(CO)]$
C. $[Co(CO)_4]^-$
D. $[IrCl(CO)(PPh_3)_2]$
(a) A and B (b) B and C (c) C and D (d) A and D

24. An organometallic fragment that is isolobal to CH_3^+ is
(a) $[Fe(CO)_5]$ (b) $[Mn(CO)_5]$ (c) $[Cr(CO)_5]$ (d) $[Ni(CO)_3]^+$

25. The calculated and observed magnetic moments (in B.M.) of aqua complex of a lanthanide ion are 0 and ~3.5, respectively. The lanthanide ion is
(a) Pm^{3+} (b) Pr^{3+} (c) Eu^{3+} (d) Sm^{3+}

26. The compound that gives a basic solution in HF is :
(a) AsF_5 (b) PF_5 (c) BF_3 (d) BrF_3

27. Based on VSEPR theory, the predicted shapes of $[XeF_5]^-$ and BrF_5 respectively, are
(a) pentagonal planar and square pyramidal
(b) square pyramidal and trigonal bipyramidal
(c) trigonal bipyramidal and square pyramidal
(d) square pyramidal and pentagonal planar

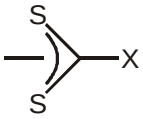
28. Both potassium and sulfuric acid form intercalation compounds with graphite. The graphite layers are
(a) reduced in both the cases
(b) oxidized in both the cases
(c) oxidized in the case of potassium and reduced in the case of sulphuric acid
(d) reduced in the case of potassium and oxidized in the case of sulphuric acid

29. The resonance Raman stretching frequencies (in cm^{-1}) of the bound O_2 species in oxy-hemerthyrin and oxy-hemoglobin, respectively, are
(a) ~850 and 1100 (b) ~750 and 850 (c) ~850 and 850 (d) ~1100 and 850

30. CdS, HgS and BiI_3, are coloured due to
(a) $L \rightarrow M$ charge transfer transitions
(b) $d \rightarrow d$ electronic transitions
(c) $M \rightarrow L$ charge transfer transitions
(d) combination of $L \rightarrow M$ charge transfer and $d \rightarrow d$ electronic transitions

31. The relative rates of water exchange for the hydrated complexes of (1) Ni^{2+}, (2) V^{2+} and (3) Cr^{3+} ions follows the trend
(a) (1) > (2) > (3) (b) (1) < (2) < (3) (c) (1) > (2) < (3) (d) (1) < (2) > (3)

32. Consider the following sulfur donor atom bearing bidentate ligand where X and name of ligands are given in following columns :



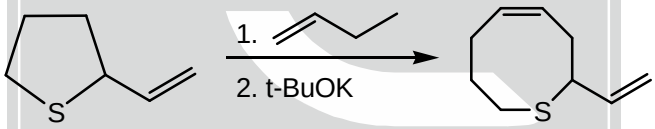
	X		Ligand name
A.	NR2	I.	Dithiocarbonate
B.	OR	II.	Dithiocarbamate
C.	O^-	III.	Xanthate
D.	SR	IV.	Thioxanthate

Correct match of entries given in two columns is
(a) A-II, B-III, C-I, D-IV (b) A-III, B-II, C-IV, D-I
(c) A-I, B-II, C-III, D-IV (d) A-IV, B-I, C-II, D-III

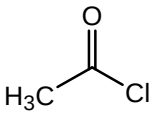
33. In *vitro* reaction of an excess of O_2 with free heme B in aqueous medium the end product is
(a) hematin (b) [O_2^- –Fe(III) -protoporphyrin-IX]
(c) heme B(O_2) (d) oxoferrylprotoporphyrin-IX cation radical

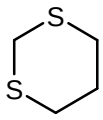
34. ^{13}C NMR spectrum of DMSO-d_6 gives a signal at δ 39.7 ppm as a
(a) singlet (b) triplet (c) quintet (d) septet

35. Following reaction is an example of



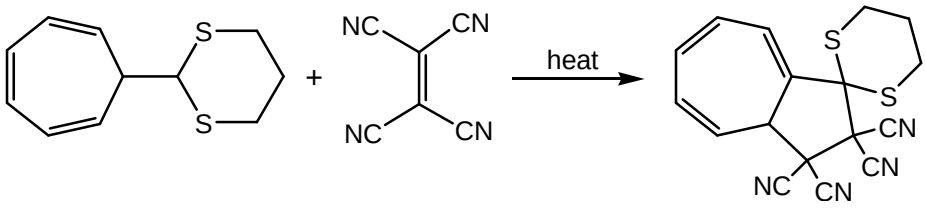
(a) Ramberg-Backlund reaction (b) [2, 3]-sigmatropic shift
(c) [3, 3]-sigmatropic shift (d) Pummerer rearrangement

36. Among the following, the synthetic equivalent of acetyl anion is
(a) 

(b) CH_3CN (c) 

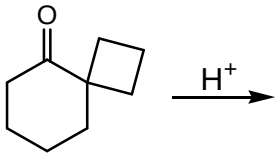
(d) $CH_3CH_2NO_2$

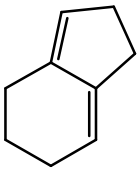
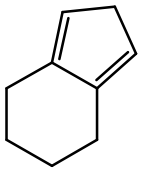
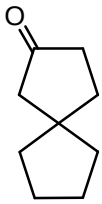
37. Following reaction is an example of

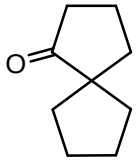


(a) [3 + 2] cycloaddition (b) [4 + 2] cycloaddition
(c) [6 + 2] cycloaddition (d) [8 + 2] cycloaddition

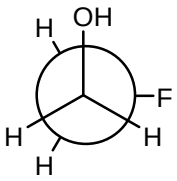
38. The major product of the following reaction is

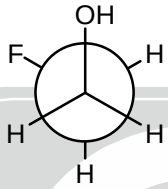


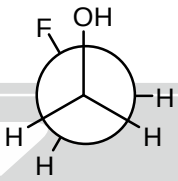
(a) 
(b) 
(c) 

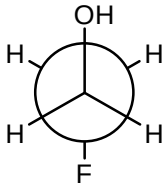
(d) 

39. The most stable conformation of 2-fluoroethanol is

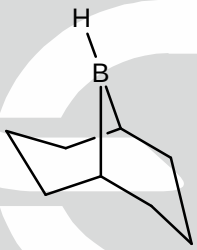
(a) 

(b) 

(c) 

(d) 

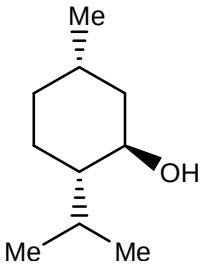
40. The IUPAC name of the following compound is



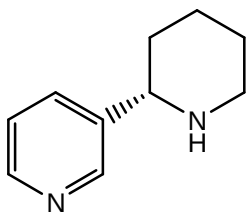
(a) 9-borabicyclo[3.3.1]nonane
(b) 1-borabicyclo[3.3.1]nonane
(c) 9-borabicyclo[3.3.0]octane
(d) 1-borabicyclo[3.3.0]octane

41. The correct match of natural products in **Column-I** with their biosynthetic precursors in **Column-II** is

Column-I **Column-II**

A. 

I. L-Lysine

B. 

II. L-Ornithine

III. Farnesyl

IV. Geranyl pyrophosphate

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

42. The correct order of pKa values for the following species is

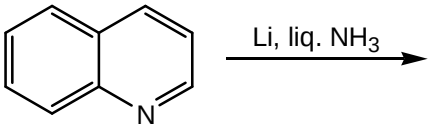
(a) $PhNH_3^+ < i\text{-}Pr_2NH_2^+ < Ph_2NH_2^+$ (b) $Ph_2NH_2^+ < PhNH_3^+ < i\text{-}Pr_2NH_2^+$

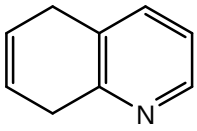
(c) $i\text{-}Pr_2NH_2^+ < Ph_2NH_2^+ < PhNH_3^+$ (d) $PhNH_3^+ < Ph_2NH_2^+ < i\text{-}Pr_2NH_2^+$

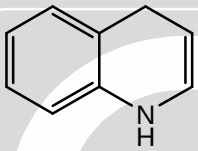
43. Among the following, the natural product that is a steroid and contains an α,β-unsaturated ketone is

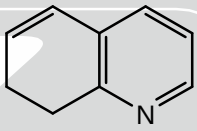
(a) estrone (b) prostaglandin (c) cortisone (d) morphine

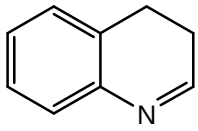
44. The major product formed in the following reaction is



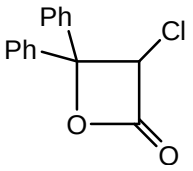
(a) 

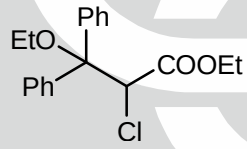
(b) 

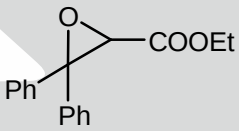
(c) 

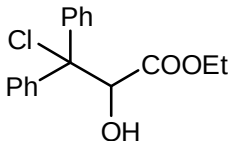
(d) 

45. The major product formed in the sodium ethoxide mediated reaction between benzophenone and ethyl chloroacetate is

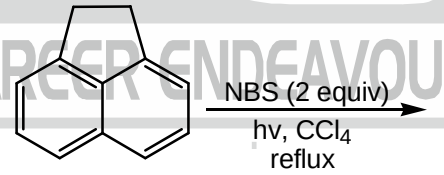
(a) 

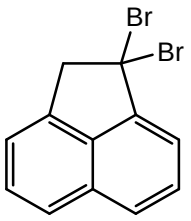
(b) 

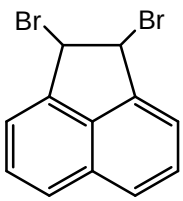
(c) 

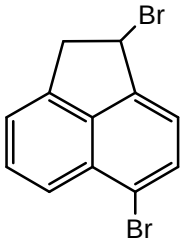
(d) 

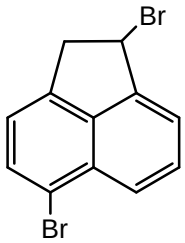
46. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

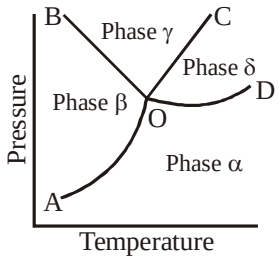
47. Consider a particle in its ground state confined to a one-dimensional box in the interval (0, 8). The probability of finding it between $4.0-\frac{\delta}{2}$ and $4.0+\frac{\delta}{2}$ is close to (δ is sufficiently small so that the wavefunction can be taken as a constant in this interval).

(a) $\frac{\delta}{4}$ (b) $\frac{\delta}{3}$ (c) $\frac{\delta}{2}$ (d) δ

48. Which of the functions below is a common eigenfunction of $\frac{d}{dx}$ and $\frac{d^2}{dx^2}$ operators ?

(a) $\cos x$ (b) kx (c) e^{ix} (d) $e - x^2$

49. A one-component system with the associated phase diagram (see the figure) is not possible because



(a) OB has a negative slops
(b) OC has a positive slope
(c) Both OB and OC are linear
(d) OB, OC and OD cannot all coexist, given OA

50. A phase transition process is always
(a) isothermal – isoentropic
(b) isochoric – isothermal
(c) isobaric – isochoric
(d) isothermal – isobaric

51. The correct statement for any cyclic thermodynamic process is

(a) $\oint dq = 0$ (b) $\oint dw = 0$ (c) $\oint dU = 0$ (d) $\oint Vdq = 0$

52. Metallic silver crystallizes in face-centred-cubic lattice structure with a unit cell of length 40 nm. The first order diffraction angle of X-ray beam from (2, 1, 0) plane of silver is 30°. The wavelength of X-ray used is close to
(a) 11 nm (b) 18 nm (c) 25 nm (d) 32 nm

53. If the pre-exponential factor in Arrhenius equation is $1.6 \times 10^{12} s^{-1}$, the value of the rate constant at extremely high temperature will be close to

(a) $1.6 \times 10^{12} s^{-1}$ (b) $4.2 \times 10^{12} s^{-1}$ (c) $2.4 \times 10^{9} s^{-1}$ (d) $1.2 \times 10^{6} s^{-1}$

54. In kinetic study of a chemical reaction, slopes are drawn at different times in the plot of concentration of reactants versus time. The magnitude of slopes with increase of time
(a) remains unchanged
(b) increases
(c) decreases
(d) increases and decreases periodically

55. The electrochemical cell potential (E), after the reactants and products reach equilibrium, is (E^0 is the standard cell potential and n is the number of electrons involved)

(a) $E = E^0 + nF/RT$ (b) $E = E^0 - RT/nF$ (c) $E = E^0$ (d) $E = 0$

56. For the electronic configuration $1s^2 2s^2 2p^4$, two of the possible term symbols are ^{1}S and ^{3}p . The remaining term is

(a) ^{1}D (b) ^{1}F (c) ^{3}D (d) ^{3}F

57. The v = 0 to 1 vibration-rotation spectrum of a diatomic molecule exhibits transitions for $R(0), R(1), P(1)$ and $P(2)$ lines at 2241, 2254, 2216 and 2203 cm^{-1}, respectively. From this data, we can conclude that the molecule
(a) has rigid rotation and harmonic vibration (b) has anharmonic vibration
(c) has rotational-vibrational interaction (d) is affected by nuclear spin-statistics

58. Consider aqueous solutions of two compounds A and B of identical concentrations. The surface tension of the solution of A is smaller than that of pure water while for B it is greater than that of pure water under identical conditions. From this one infers that
(a) surface concentration of A is smaller than its bulk concentration
(b) surface concentration of B is larger than its bulk concentration
(c) surface concentration of A is larger than that of B
(d) surface concentration of A is smaller than that of B

59. For a monodisperse polymer, the number-average molar mass $\left(\bar{M}_n\right)$ and weight-average molar mass $\left(\bar{M}_w\right)$ are related according to
(a) $\bar{M}_w < \bar{M}_n$ (b) $\bar{M}_w = \bar{M}_n$ (c) $\bar{M}_w > \bar{M}_n$ (d) $\bar{M}_w < \log \bar{M}_n$

60. An intense purple colour (Plasmon band) is exhibited by a colloid consisting of spherical
(a) silver particles of 10 mm diameter (b) silicon particles of 5 mm diameter
(c) gold particles of 5 nm diameter (d) iron particles of 3 mm diameter

PART-C

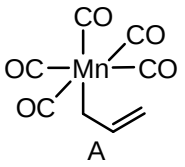
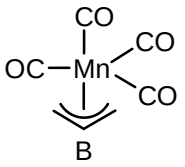
61. Choose the correct statement for magnitude of threshold energy of an endoergic nuclear reaction between stationary nucleus and a moving projectile.
(a) It is greater than '$|Q|$' of nuclear reaction.
(b) It has to be more than kinetic energy of a projectile.
(c) It is less than '$|Q|$' of nuclear reaction.
(d) It has to be equal to kinetic energy of a projectile.

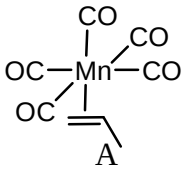
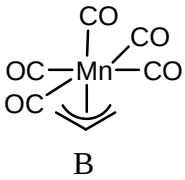
62. Identify correct statements from the following:
A. Area of differential thermal analysis peak is proportional to amount of sample.
B. Area of differential thermogravimetric analysis curve is proportional to mass loss.
C. Phase transition cannot be studied with differential scanning calorimetry.
D. Simulatneous determination of two metal ions is possible with thermogravimetric analysis.
Answer is
(a) A, B and C (b) A, B and D (c) B, C and D (d) A, C and D

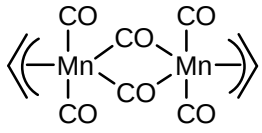
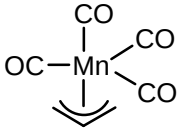
63. Consider following statements for fission of ^{235}U with thermal neutrons.
A. The % of nuclei undergoing unsymmetrical fission is maximum.
B. In each fission, one thermal neutron is produced.
C. Magnitude of energy released per fission is of the order 200 MeV
Correct statement(s) is/are
(a) A and B (b) A and C (c) B and C (d) C only

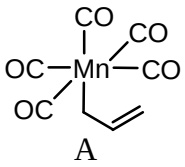
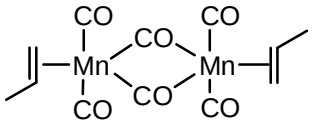
64. Addition of two electrons to the bismuth cluster Bi_5^{3+} results in a change of structure type from
(a) closo to nido (b) nido to arachno (c) closo to arachno (d) arachno to hypho

65. Reaction of $Na\left[Mn(CO)_5\right]$ with $H_2C=CHCH_2Cl$ gives **A** along with NaCl. Photolysis of compound **A** results in compound **B** together with elimination of CO. the correct structural formulations of compounds A and **B** are respectively,

(a)  A  B

(b)  A  B

(c)  A  B

(d)  A  B

66. A copper(II) complex having distorted octahedral geometry shows an absorption band at 625 nm. Given spin-orbit coupling of the complex as –625 cm^{-1}, the μ_{eff} (in B.M.) is

(a) 1.73 (b) 1.81 (c) 1.63 (d) 1.93

67. Match items in column A with items in column B:

Column A	Column B
I: $SbF_5 + BrF_3 \rightarrow \left[BrF_2\right]^+ + \left[SbF_6\right]^-$	A. Lewis acid behaviour of BrF_3
II: $\left[BrF_2\right]\left[SbF_6\right] + Ag\left[BrF_4\right] \rightarrow Ag\left[SbF_6\right] + 2BrF_3$	B. Lewis base behaviour of BrF_3
III: $KF + BrF_3 \rightarrow K^+ + \left[BrF_4\right]^-$	C. Self ionisation
IV: $2BrF_3 \rightarrow \left[BrF_2\right]^+ + \left[BrF_4\right]^-$	D. Neutralisation

The correct answer is

(a) I-(A); II-(B); III-(C); IV-(D) (b) I-(B); II-(D); III-(C); IV-(A)

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

68. Mössbauer spectrum of complex $\left[Fe(1,10-\text{phenanthroline})_2(NCS)_2\right]$ shows two lines at 300 K, four lines at 186 K, and again two lines at 77 K. This can be attributed to

A. change in the coordination mode of NCS

B. change in the spin-state of iron

C. cis-trans isomerisation

D. change in metal-ligand bond distances

The correct statements are

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

69. $(R_3Ge)_2$ on photolysis gives a radical which shows ESR spectrum. The ESR signals carrying the signature of $^{73}Ge(I=9/2)$ are in terms of

(a) Nine lines (b) Ten lines (c) Two lines (d) One line

70. Mass fragment of $[IrCl]^+$ in mass spectrometry shows three mass peaks at m/z = 226, 228, and 230. Given that natural abundances of ^{191}Ir, ^{193}Ir, ^{35}Cl and ^{37}Cl are 37%, 63%, 76%, and 24% respectively, the intensities of the mass peaks are in the order
(a) 49.5 : 100 : 26.6 (b) 100: 49.5: 26.6 (c) 26.6: 100: 49.5 (d) 26.6: 49.5: 100

71. The $^{31}P\{^1H\}$ NMR spectrum of 2,2,6,6-$N_4P_4Cl_4(NMe_2)_4$ is expected to show
(a) two triplets (b) two doublets
(c) one doublet and one triplet (d) one quartet and one doublet

72. The number of bonding molecular orbitals and the number of available skeletal electrons in $[B_6H_6]^{2-}$, respectively, are
(a) 7 and 14 (b) 6 and 12 (c) 18 and 12 (d) 11 and 14

73. The compound N_2F_2 has two isomers. Choose the correct option from the following:
(a) both isomers possess σ_v plane
(b) both isomers possess σ_h plane
(c) one isomer has σ_h plane while the other has a σ_v plane
(d) none of them have a σ_h plane

74. Consider the following statements for metallothioneins:
A. the contain about 30% cysteine residues
B. they prefer to bind soft metal ions such as Cd(II), Hg(II) and Zn(II)
C. they are involved in electron transfer reactions
D. they are low molecular weight proteins
Correct statements are
(a) A, B and C (b) A, B and D (c) A, C and D (d) B and C

75. Consider the following statements for deoxy-hemerythrin and deoxy-hemocyanin:
A. they are involved in O_2 transport in biological systems
B. they contain two metal ions in their active site
C. active site metal centres are bridged by amino acid residues
D. they prefer to bind only one O_2 per active site
The correct statements are
(a) A, B and D (b) A, C and D (c) B, C and D (d) A and C

76. Consider the following statements for octahedral complexes, (a) $[CrF_6]^{3-}$, (b) $[Cr(ox)_3]^{3-}$ and (c) $[Cr(en)_3]^{3+}$:
A. their d→d transitions are at 14900, 17500, and 21800 cm^{-1}, respectively
B. their spin-only magnetic moments are same
C. two of them have optical isomers
D. all of them show Jahn-Teller distortion
The correct statements are
(a) A, B, and C (b) A, C, and D (c) B, C, and D (d) B and D

77. Addition of $NaBH_4$ to $\left[\left(\eta^5-Cp\right)Fe\left(\eta^6-C_6H_6\right)\right]^+$ will give

(a) $\left[\left(\eta^5-Cp\right)Fe\left(H\right)_2\right]^-$ (b) $\left[\left(\eta^5-Cp\right)Fe\left(H\right)\left(\eta^6-C_6H_6\right)\right]$

(c) $\left[\left(\eta^5-Cp\right)Fe\left(\eta^6-C_6H_6\right)\right]$ (d) $\left[\left(\eta^5-Cp\right)Fe\left(\eta^6-C_6H_7\right)\right]$

78. The μ_{eff} of $\left[Fe\left(S_2CNEt_2\right)_3\right]$ changes with temperature with the involvement of two electronic states. The states are

(a) low spin $^2T_{2g}$ and high-spin $^6A_{1g}$. (b) low spin $^1A_{1g}$ and high-spin $^3T_{2g}$

(c) low spin ^2E_g and high-spin $^6A_{1g}$. (d) low spin $^2T_{2g}$ and high-spin $^4T_{1g}$.

79. Match the items in the three columns.

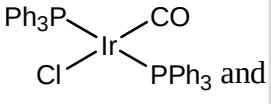
Complex (column 1)	Color (column 2)	Absorption max (λ_{max}, nm) (column 3)
A. $\left[Ni\left(H_2O\right)_6\right]\left(NO_3\right)_2$	I. Blue	X. 675
B. $\left[Ni\left(NH_3\right)_6\right]\left(NO_3\right)_2$	II. Green	Y. 565
C. $\left[Ni\left(en\right)_3\right]\left(NO_3\right)_2$	III. Violet	Z. 615

The correct answer is

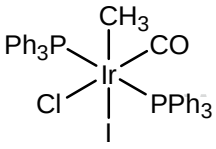
(a) A-II-X; B-I-Z; C-III-Y (b) A-I-X; B-II-Y; C-III-Z

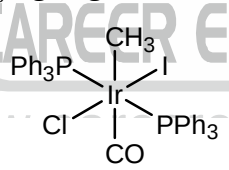
(c) A-III-Y; B-I-Z; C-II-X (d) A-I-X; B-II-Z; C-III-Y

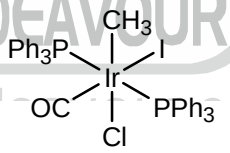
80. Identify the product in the reaction between

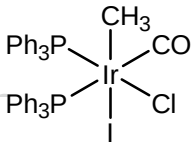


and CH_3I going at room temperature *via* S_N2 mechanism

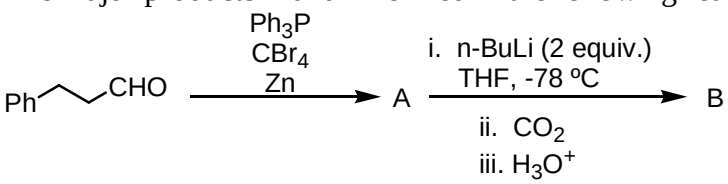
(a) 

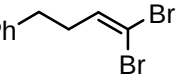
(b) 

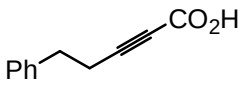
(c) 

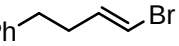
(d) 

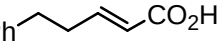
81. The major products A and B formed in the following reactions sequence are

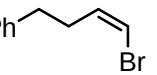


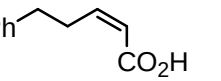
(a) A = 

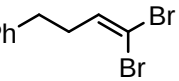
B = 

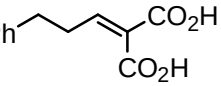
(b) A = 

B = 

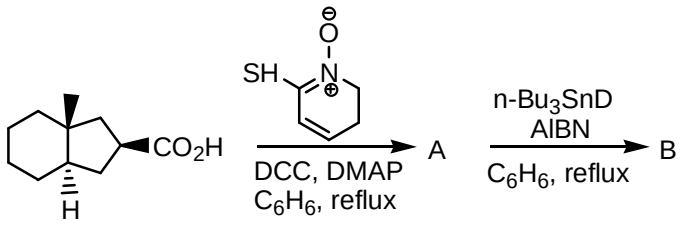
(c) A = 

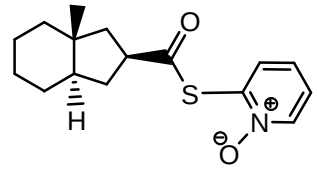
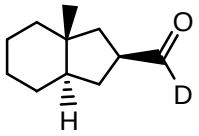
B = 

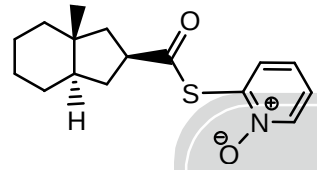
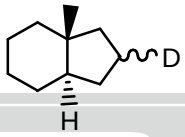
(d) A = 

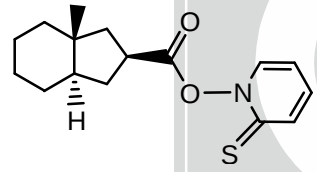
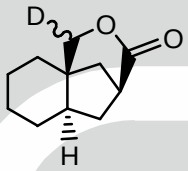
B = 

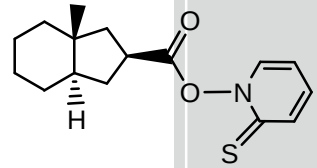
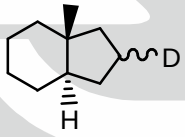
82. The intermediate **A** and product **B** formed in the following reaction sequence are



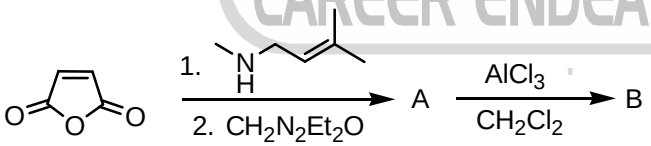
(a) A =  B = 

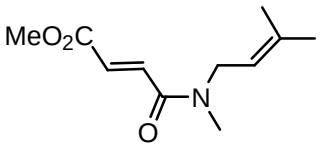
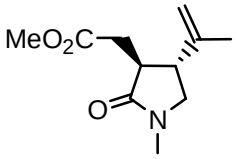
(b) A =  B = 

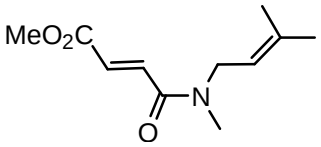
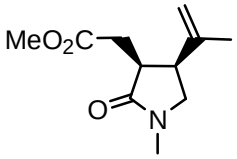
(c) A =  B = 

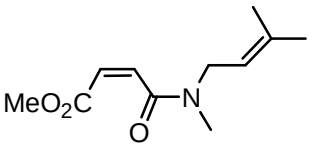
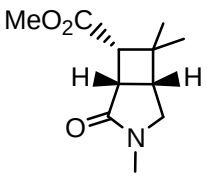
(d) A =  B = 

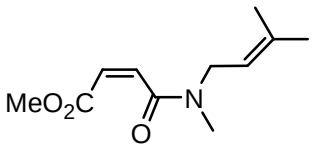
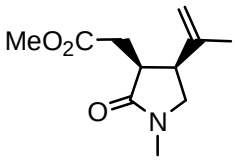
83. The major products A and B formed in the following reaction sequence are



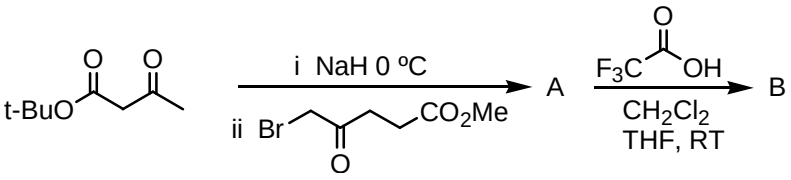
(a) A =  B = 

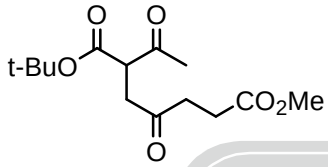
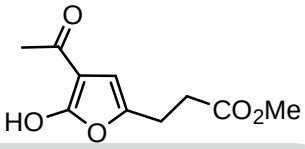
(b) A =  B = 

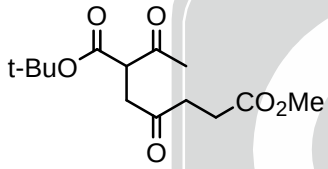
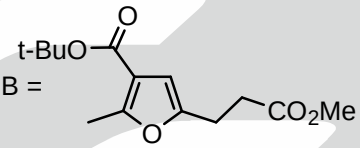
(c) A =  B = 

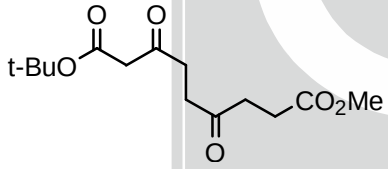
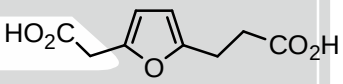
(d) A =  B = 

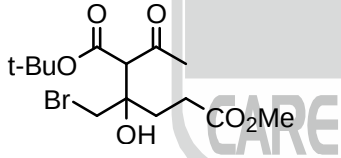
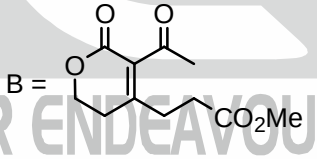
84. The major products **A** and **B** formed in the following reaction sequence are



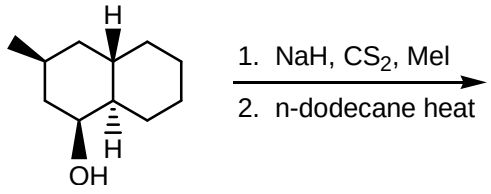
(a) A =  B = 

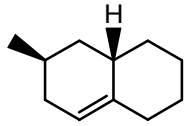
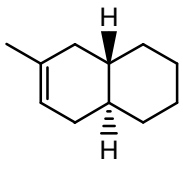
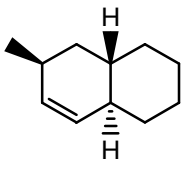
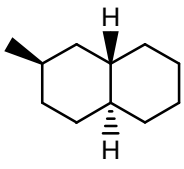
(b) A =  B = 

(c) A =  B = 

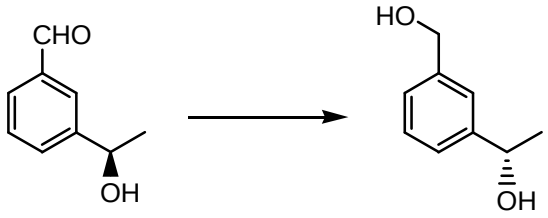
(d) A =  B = 

85. The major product formed in the following reaction is



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

86. The correct combination of reagents to effect the following reaction is



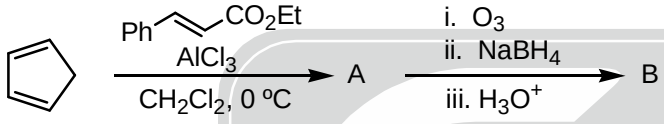
(a) A. $POCl_3$, pyridine; B. AgOAc ; C. $LiAlH_4$

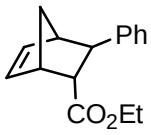
(b) A. $NaBH_4$; B. Ph_3P, DEAD, $PhCO_2H$

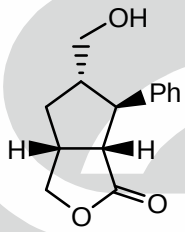
(c) A. Ph_3P, DEAD, $PhCO_2H$; B. $LiAlH_4$

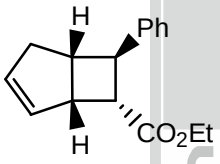
(d) A. PCC ; B. L-selectride

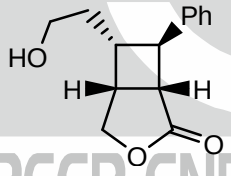
87. The major products A and B formed in the following reaction sequence are

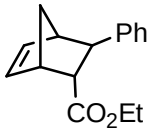


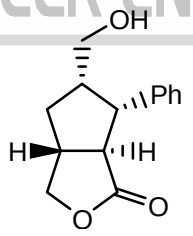
(a) A = 

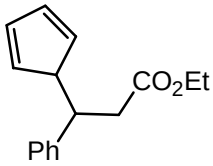
B = 

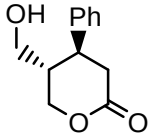
(b) A = 

B = 

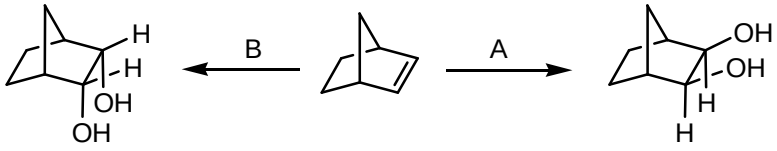
(c) A = 

B = 

(d) A = 

B = 

88. The correct combination of reagents A and B to effect following transformations are



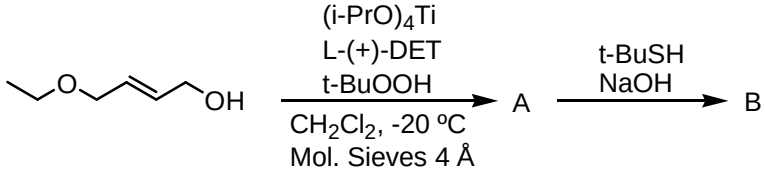
(a) A = cat. OsO_4, NMO; B = i. I_2, $PhCO_2Ag$, ii. aq. NaOH

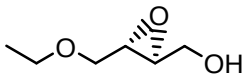
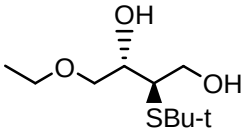
(b) A = alkaline $KMnO_4$; B = i. I_2, $PhCO_2Ag$, H_2O, ii. aq. NaOH

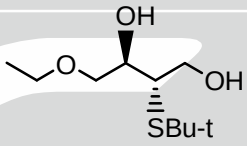
(c) A = I_2, $PhCO_2Ag$, ii. aq. NaOH; B = cat. OsO_4, TMEDA, NMO

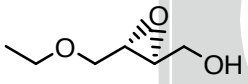
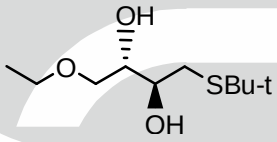
(d) A = i. m-CPBA, ii. aq. NaOH; B = alkaline $KMnO_4$

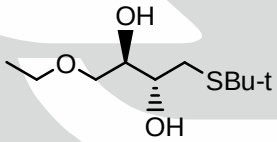
89. The major products A and B formed in the following reaction sequence are



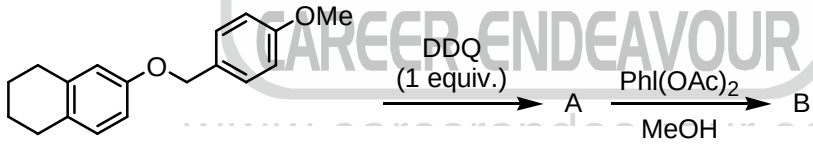
(a) A =  B = 

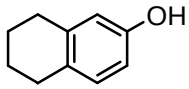
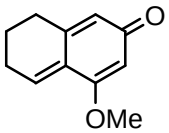
(b) A =  B = 

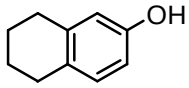
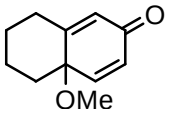
(c) A =  B = 

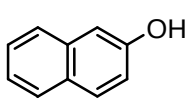
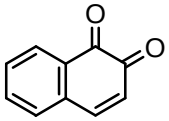
(d) A =  B = 

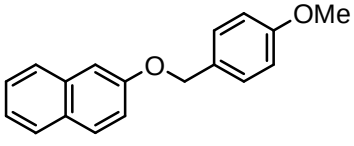
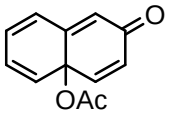
90. The major products A and B formed in the following reaction sequence are



(a) A =  B = 

(b) A =  B = 

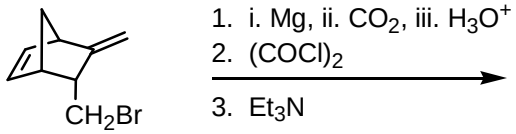
(c) A =  B = 

(d) A =  B = 

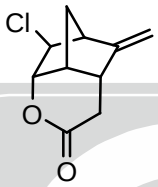
91. The specific rotation $[\alpha]_D$ for (S)–(+)–2–butanol is 10° mL/g dm. The observed optical rotation (α_{obs}) of a sample composed of a mixture of (R)- and (S)-2-butanol is –0.45°. If the cell path length is 0.6 dm and the concentration of 2-butanol in the sample is 0.15 g/mL, the percentages of (R) and (S) enantiomers in the sample are

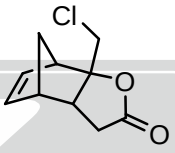
(a) (R) = 25%, (S) = 75% (b) (R) = 40%, (S) = 60%
(c) (R) = 60%, (S) = 40% (d) (R) = 75%, (S) = 25%

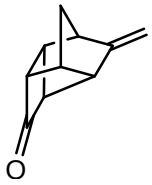
92. The major product formed in the following reaction is



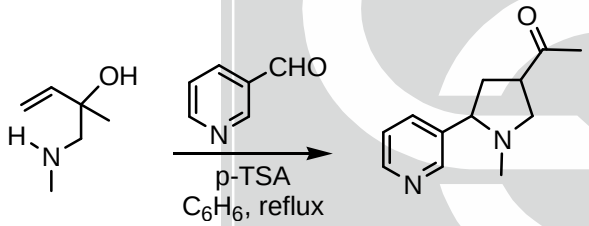
(a) 

(b) 

(c) 

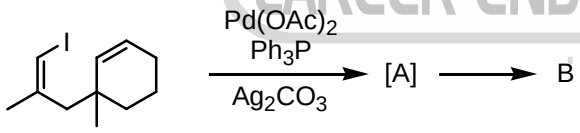
(d) 

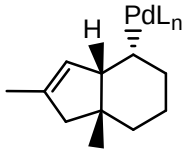
93. Following reaction involves

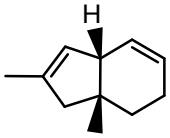


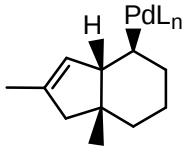
(a) Claisen followed by Mannich reaction (b) aza-Cope followed by Mannich reaction
(c) Claisen followed by aza-aldol reaction (d) aza-Cope followed by aza-aldol reaction

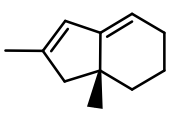
94. The intermediate A and the major product B formed in the following reaction is

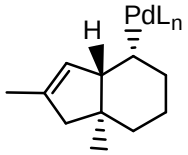


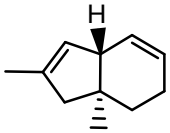
(a) A = 

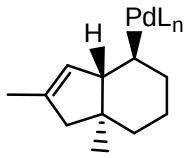
B = 

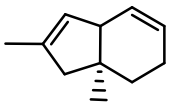
(b) A = 

B = 

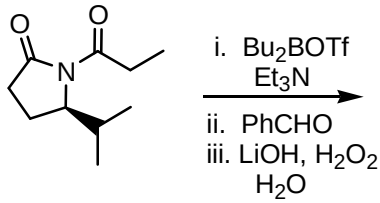
(c) A = 

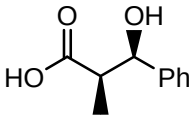
B = 

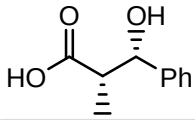
(d) A = 

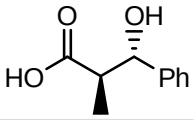
B = 

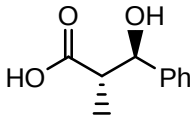
95. The major product formed in the following reaction is



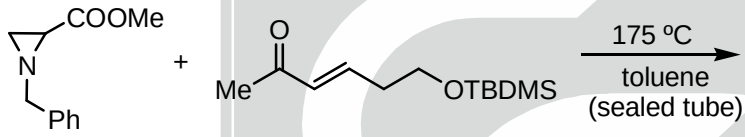
(a) 

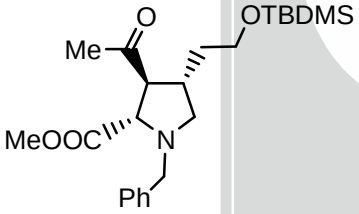
(b) 

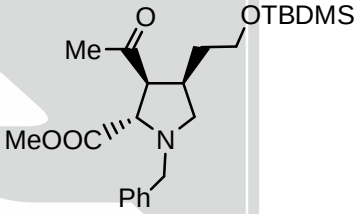
(c) 

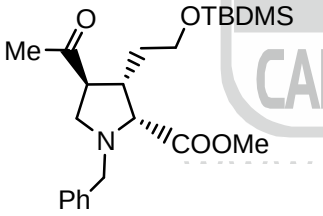
(d) 

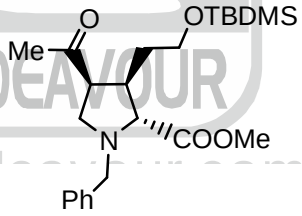
96. The major product formed in the following reaction is



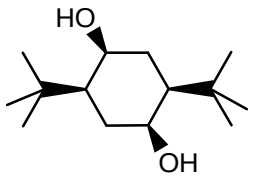
(a) 

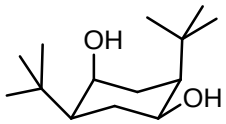
(b) 

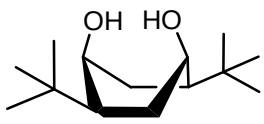
(c) 

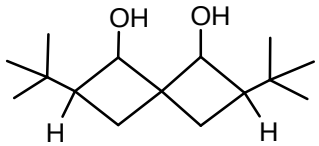
(d) 

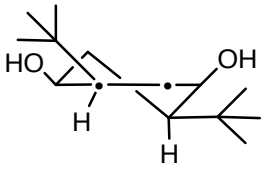
97. The most stable conformation for the following compound is



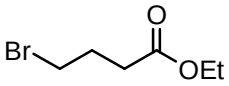
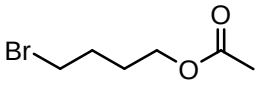
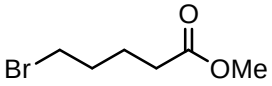
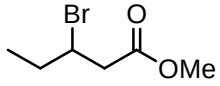
(a) 

(b) 

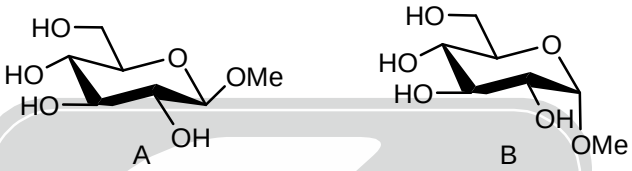
(c) 

(d) 

98. The correct structure of the compound based on the following characteristic spectral data is
IR: 1736 cm^{-1}
^1H NMR: δ 3.59 (s, 3H), 3.32 (t, 2H), 2.25 (t, 2H), 1.85-1.75 (m, 2H), 1.73-1.62 (m, 2H)
^{13}C NMR: δ 174.0, 51.0, 32.9, 32.9, 32.8, 31.0, 23.0

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

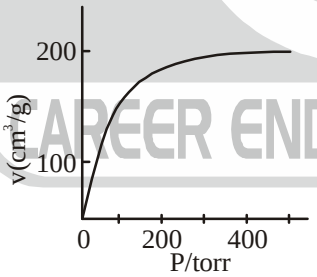
99. The major product formed in the reaction of D-glucose with $ZnCl_2$ in MeOH is a methyl glucopyranoside (A or B). The structure of this product and the molecular orbital interaction present between ring-oxygen and the anomeric C-O bond responsible for its stability, respectively, are



(a) A and $n \rightarrow \sigma^*$ (b) A and $n \rightarrow \sigma$ (c) B and $n \rightarrow \sigma^*$ (d) B and $n \rightarrow \sigma$

100. Among the following correct statement for nucleic acids is
(a) Uracil is present in DNA
(b) Uracil is present in RNA
(c) Phosphorylation in RNA is at 2' and 5' positions
(d) Normally three hydrogen bonds stabilize A-T base pair

101. The figure below depicts an adsorption isotherm of O_2 on charcoal at 90 K.



At a pressure 25 torr, only 10% of charcoal sites are occupied by O_2. Therefore, the ratio of adsorption to desorption rate constants (in $torr^{-1}$) is close to
(a) 0.003 (b) 0.004 (c) 0.006 (d) 0.015

102. Polonium is the only metal known to exist in a simple cubic lattice form. The density of polonium at 0°C is measured to be 10.00 g/cm^3. The atomic radius of polonium would then be (assume the mass of a polonium atom = 2.7×10^{-22} g)
(a) 1.1 Å (b) 1.9 Å (c) 1.5 Å (d) 2.3 Å

103. The specific conductance of a solution is $0.176\,\Omega^{-1}cm^{-1}$. If the cell constant is 0.255 cm^{-1}, the conductance $\left(\Omega^{-1}\right)$ of that solution is
(a) 1.449 (b) 0.690 (c) 0.045 (d) 0.431

104. Photochemical decomposition of HI takes place with the following mechanism

$HI + hv\,(I_a) \longrightarrow H + I$

$H + HI \xrightarrow{k_1} H_2 + I$

$I + I + M \xrightarrow{k_2} I_2 + M$

Considering hydrogen (H) and iodine (I) atoms as intermediates, the rate of removal of HI is

(a) $I_a/2$ (b) I_a (c) $2I_a$ (d) I_a^2

105. In an enzyme-catalysed reaction

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

$k_2 = 3.42 \times 10^4 s^{-1}$. If $[E]_0 = 1 \times 10^{-2}$ mol dm^{-3}, the magnitude of maximum velocity and turn over number using Michaelis-Menten kinetics are

(a) 3.42×10^2 mol dm^{-3}s^{-1}; 3.42×10^4 s^{-1} (b) 3.42×10^6 mol dm^{-3}s^{-1}; 3.42×10^4 s^{-1}

(c) 3.42×10^4 mol dm^{-3}s^{-1}; 3.42×10^6 s^{-1} (d) 3.42×10^4 mol dm^{-3}s^{-1}; 3.42×10^2 s^{-1}

106. Arrhenius equations for two chemical reactions are: $k_1 = A_1 e^{-E_1/RT}$, $k_2 = A_2 e^{-E_2/RT}$. If $E_1 > E_2$, then at a given temperature *T*,

(a) $\frac{k_1}{k_2} < \frac{A_1}{A_2}$ (b) $\frac{k_2}{k_1} < \frac{A_2}{A_1}$ (c) $k_1 k_2 > A_1 A_2$ (d) $k_1 + k_2 > A_1 + A_2$

107. The fugacity of a real gas is less than the pressure (P) of an ideal gas at the same temperature (T) only when (T_b is the Boyle temperature of the real gas)

(a) high $P, T < T_b$ (b) low $P, T < T_b$ (c) high $P, T > T_b$ (d) low $P, T > T_b$

108. For the reaction $H_2O(g) \rightleftharpoons H_2(g) + \frac{1}{2}O_2(g)$, the equilibrium constant K_p depends on the degree of dissociation $\alpha(\alpha << 1)$ and total pressure P as

(a) $K_p \propto \alpha^2 P$ (b) $K_p \propto \alpha^{3/2} P^{1/2}$ (c) $K_p \propto \alpha^{1/2} P^{3/2}$ (d) $K_p \propto \alpha P^2$

109. The minimum work required by an engine to transfer 5 J of heat from a reservoir at 100 K to one at 300 K is

(a) 5 J (b) 10 J (c) 15 J (d) 20 J

110. The correct relation involving symmetry operations

(a) $S_4^2 = S_2$ (b) $\sigma(xz)\sigma(yz) = C_2(x)$

(c) $S_4^3 = C_4^3$ (d) $S_6^3 = S_2$

111. A polydisperse polymer sample has ten molecules of molar mass 20,000 g mol^{-1} and fifteen molecules of molar mass 10,000 g mol^{-1}. The number-average molar mass $(g\ mol^{-1})(\bar{M}_n)$ of the sample is

(a) 13,000 (b) 14,000 (c) 15,000 (d) 16,000

112. Consider a system of three particles which can occupy energy levels with energy 0, ε and 2ε, such that the total energy $E = 4\varepsilon$. Cases A, B and C correspond to spin $\frac{1}{2}$ fermions, spin 0 bosons, and classically distinguishable particles, respectively. The correct ordering of entropy is

(a) $S_A > S_B > S_C$ (b) $S_B > S_A > S_C$ (c) $S_C > S_B > S_A$ (d) $S_C > S_A > S_B$

113. For a point group, an incomplete character table is given below with one irreducible representation missing

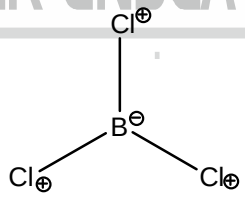
	E	$2C_3$	$3\sigma_v$
A_1	1	1	1
–	–	–	–
E	2	−1	0

The Mulliken symbol and characters of the missing representation are

(a) A_1' 1 −1 1 (b) B_1 1 −1 −1 (c) A_2 1 1 −1 (d) B_2 1 −1 1

114. Given below is a specific vibrational mode of BCl_3 with ⊕ and ⊖ denoting movements of the respective atoms above and below the plane of the molecule respectively. The irreducible representation of the vibrational mode and its *IR* / Raman activity are

D_{3h}	E	$2C_3$	$3C_2$	σ_b	$2S_3$	$3\sigma_v$		
A_1	1	1	1	1	1	1		x^2+y^2, z^2
A_2	1	1	−1	1	1	−1	R_z	
E'	2	−1	0	2	−1	0	(x, y)	(x^2-y^2, xy)
A_1''	1	1	1	−1	−1	−1		
A_2''	1	1	−1	−1	−1	1	z	
E''	2	−1	0	−2	1	0	(R_x, R_y)	(xz, yz)



(a) A_2'; neither *IR* nor Raman active (b) E'; both *IR* and Raman active

(c) A_1'; Raman active (d) A_2''; *IR* active

115. The first excited state $\left({}^2P_{1/2}\right)$ of fluorine lies at an energy of 400 cm^{-1} above the ground state $\left({}^2P_{3/2}\right)$. The fraction of Fluorine atoms in the first excited state at $k_BT = 420\ cm^{-1}$ is close to

(a) $\frac{1}{1+e}$ (b) $\frac{1}{2+e}$ (c) $\frac{1}{1+4e}$ (d) $\frac{1}{1+2e}$

116. The two limiting wavefunctions of the ground state of H_2^+ molecular ion, as the internuclear separation R goes to (i) ∞ (infinity) and (ii) 0 (zero) are ($1s_a, 1s_b$ are 1s-orbital wave functions of hydrogen atoms *a* and *b* in H_2^+, and $1s_{He}$ is the wave function of the 1s orbital of He^+)

(a) (i) $1s_a(r)$; (ii) $1s_b(r)$ (b) (i) $1s_b(r)$; (ii) $1s_a(r)$

(c) (i) $1s_a(r_1)1s_b(r_2)$; (ii) $1s_{He}(r_1)1s_{He}(r_2)$ (d) (i) $1s_a(r)+1s_b(r)$; (ii) $1s_{He}(r)$

117. For a certain magnetic field strength, a free proton spin transition occurs at 700 MHz. Keeping the magnetic field strength constant the ^{14}N nucleus will resonate at $\left(g(p) \simeq 5.6 \text{ and } g(^{14}N) \simeq 0.4\right)$

(a) 700 MHz (b) 400 MHz (c) 200 MHz (d) 50 MHz

118. The first electronic absorption band maximum of a polar and relatively rigid aromatic molecule appears at 310 nm but its fluorescence maximum in acetonitrile solution appears with a large Stokes shift at 450 nm. The most likely reason for the Stokes shift is

(a) large change in molecular geometry in the excited state
(b) increase in dipole moment of the molecule in the excited state
(c) decrease in polarizability of the molecule in the excited state
(d) lowered interaction of the excited molecule with polar solvent

119. The un-normalized radial wave function of a certain hydrogen atom eigenstate is $(6r - r^2)\exp(-r/3)$. A possible angular part of the eigenstate is

(a) $5\cos^3\theta - 3\cos\theta$ (b) $3\cos^2\theta - 1$ (c) $\cos\theta$ (d) 1

120. Given a trial wave function $\psi_t = C_1\phi_1 + C_2\phi_2$, and the Hamiltonian matrix elements, $\int \phi_1^* H \phi_1 dv = 0$, $\int \phi_1^* H \phi_2 dv = 2.5$, $\int \phi_2^* H \phi_2 dv = 12.0$, the variationally determined ground state energy is

(a) –0.52 (b) –0.50 (c) 12.50 (d) 12.52

○○○

PART–B

21. 2, 8, 20, 28, 50, 82 and 126 are magic number.
Correct option is (c)

22. Phosphorescence has been observed form a wide variety of compounds and is differentiated from fluorescence by long lived emission of light after extinction of the excitation source i.e. it done after fluorescence, if parsists.
Phosphorescence increases when heavy atoms like iodine silver and lead etc. are added.
Phosphorescence increases, when analyte used become immobile.
Hence, both (A) and (B) are correct.
Correct option is (b)

23. The species having same number of electrons are called isoelectronic.

$A = \left[V(CO)_6 \right] = 5 + 12 = 17\ e^-$

$B = \left[Cu\left(\eta^5 - C_5H_5\right)(CO) \right] = 11 + 5 + 2 = 18\ e^-$

$C = \left[Co(CO)_4 \right]^- = 9 + 8 + 1 = 18\ e^-$

$D = \left[IrCl(CO)(PPh_3)_2 \right] = 9 + 1 + 2 + 4 = 16\ e^-$

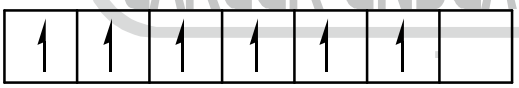
Correct option is (b)

24. Two fragments are isolobal if the number, symmetry properties, approximate energy and shape of their frontier molecular orbitals and the number of electrons in them are similar not identical but similar.

$CH_3^+ = 4 + 3 - 1 = 6$; $\left[Cr(CO)_5 \right] = 6 + 10 = 16$

Correct option is (c)

25. $Eu^{3+} = f^6$



L = 6–3 = 3 J = |L–S| = 0
S = 3

Hence, $\mu = g\sqrt{J(J+1)} = 0$

Correct option is (c)

26. $AsF_5 + 2HF \rightleftharpoons \left[AsF_6\right]^- + \left[H_2F\right]^+$

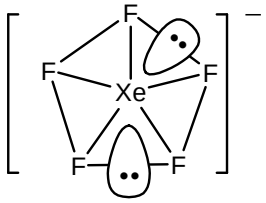
$PF_5 + 2HF \rightleftharpoons \left[PF_6\right]^- + \left[H_2F\right]^+$

$BF_3 + 2HF \rightleftharpoons \left[BF_4\right]^- + \left[H_2F\right]^+$

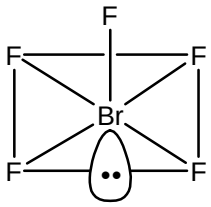
$BrF_3 + HF \rightleftharpoons \left[BrF_2\right]^+ + \left[HF_2\right]^-$

BrF_3 acts as base as it donate F^- in HF.

Hence, **correct option is (d)**

27. $[XeF_5]^- \Longrightarrow$ 

Shape = Pentagonal planar

$[BrF_5] \Longrightarrow$ 

Shape = square pyramidal

Correct option is (a)

28. $K + \text{graphite} \Rightarrow [\text{graphite}]^- K^+$

$H_2SO_4 + \text{graphite} = [\text{graphite}]^+ HSO_4^-$

Correct option is (d)

29. In oxyhemerythrin $\nu_{O-O} = 850\ \text{cm}^{-1}$

In oxyhemoglobin $\nu_{O-O} = 1100\ \text{cm}^{-1}$

Correct option is (a)

30. In CdS, HgS and BiI_3 colour is due to LMCT as Cd^{2+} and Hg^{2+} has d^{10} configuration. Hence, no d-d transition. Also, no MLCT as ligand is not π-acceptor.

Hence, correct option is (a).

31. Change in CFSE on going for O_h to five coordinate intermediate for ions is as follows.

$V^{2+}\left(d^3\right) = -2.00$

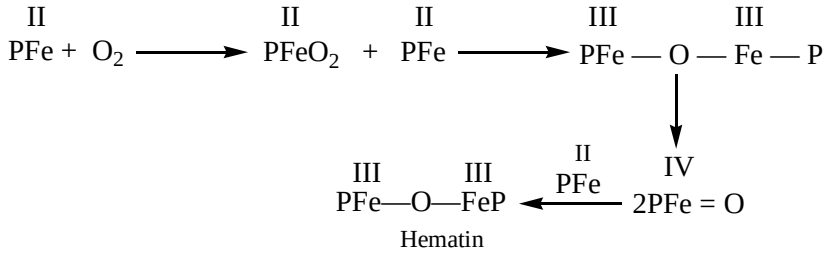
$Cr^{3+}\left(d^3\right) = -2.00$

$Ni^{2+}\left(d^8\right) = -2.00$

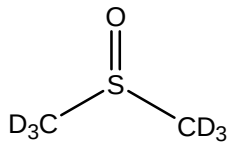
Correct option is (a)

32. NR_2 $\rightarrow$ Dithiocarbamate
OR $\rightarrow$ Xanthate
O^- $\rightarrow$ Dithiocarbonate
SR $\rightarrow$ Thioxanthate

Correct option is (a)

33. 

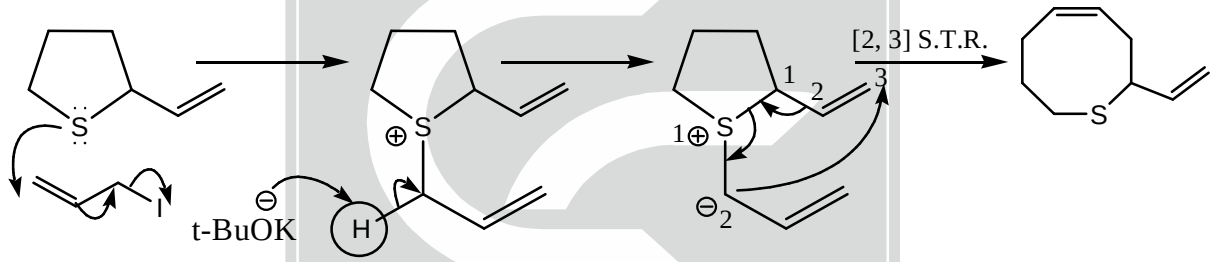
Correct option is (a)

34. 

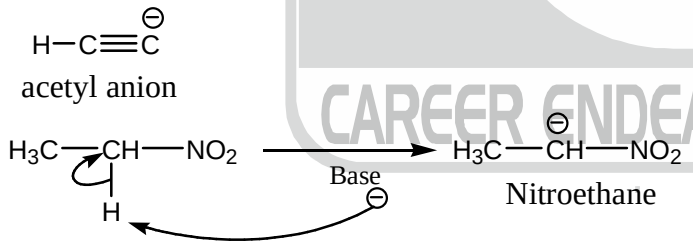
^{13}C NMR n = 3; I = 1 (for D)

Multiplicity = $2nI + 1 = 2\times3\times1 + 1 = 6 + 1 = 7$ (septet)

Correct option is (d)

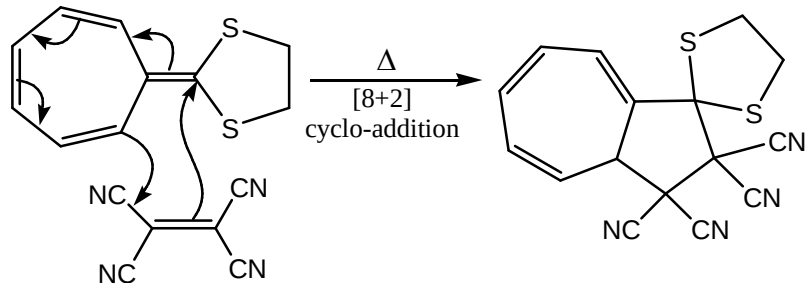
35. 

Correct option is (b)

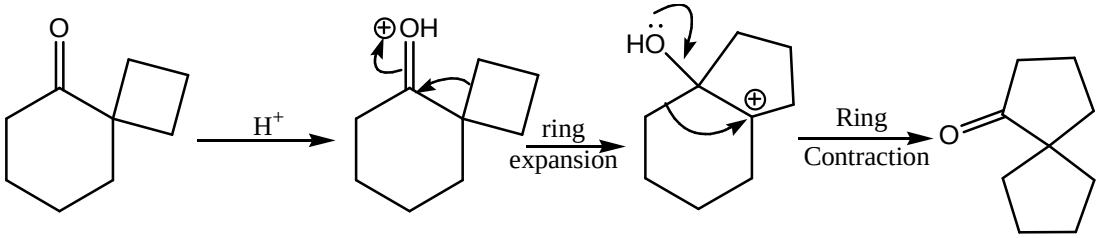
36. 

Hence, nitroethane anion is synthetic equivalent of acetyl anion.

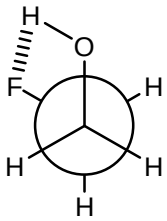
Correct option is (d)

37. 

Correct option is (d)

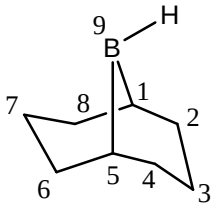
38. 

Correct option is (d)

39. 

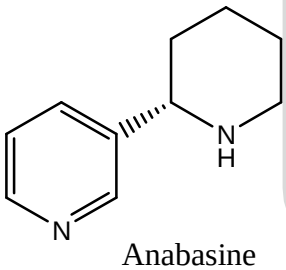
Most stable due to intramolecular hydrogen bonding

Correct option is (b)

40. 

9-borabicyclo [3, 3, 1] nonane

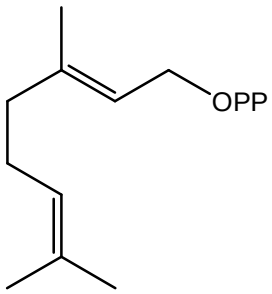
Correct option is (a)

41. 

Anabasine

It is a pyridine and piperidine alkaloid found in the tree tobacco plant. Its principal industrial use is an insecticide.

Lysine serves as the precursor of piperidine ring of anabasine.



Gernyl pyrophosphate is the biosynthetic precursor of (+)–menthol.

Correct option is (a)

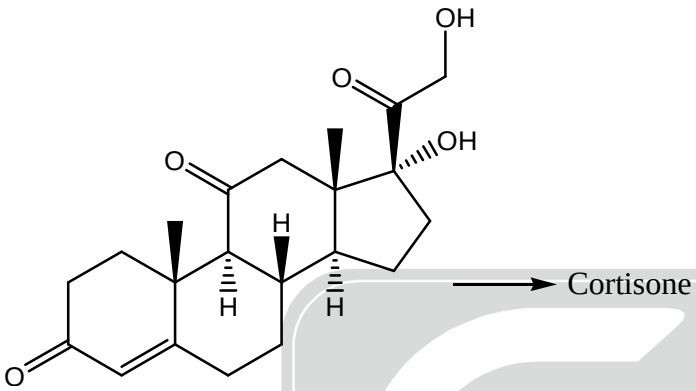
42. Basicity order for their conjugate base is

$^{i}Pr_2NH > PhNH_2 > Ph_2NH$

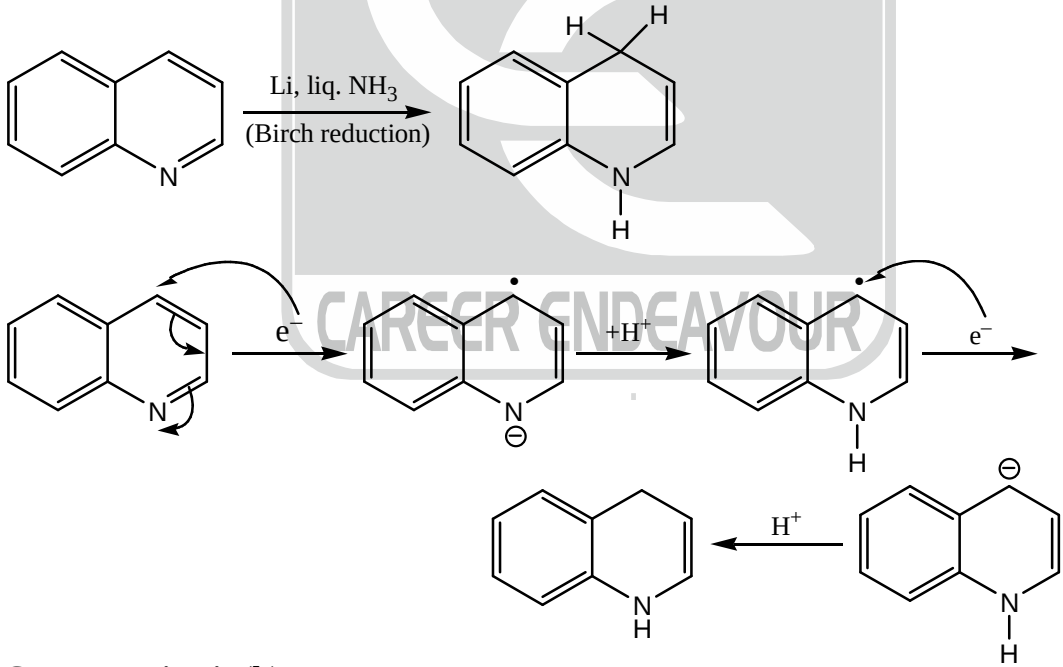
Hence, pKa value for their conjugate acid

$$\xleftarrow[pK_a]{^{i}PrNH_2^{+} > PhNH_3^{+} > Ph_2NH_2^{+}}$$

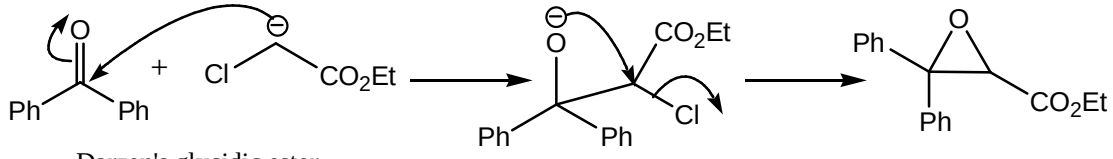
Hence, correct option is (b)

43. 

Correct option is (c)

44. 

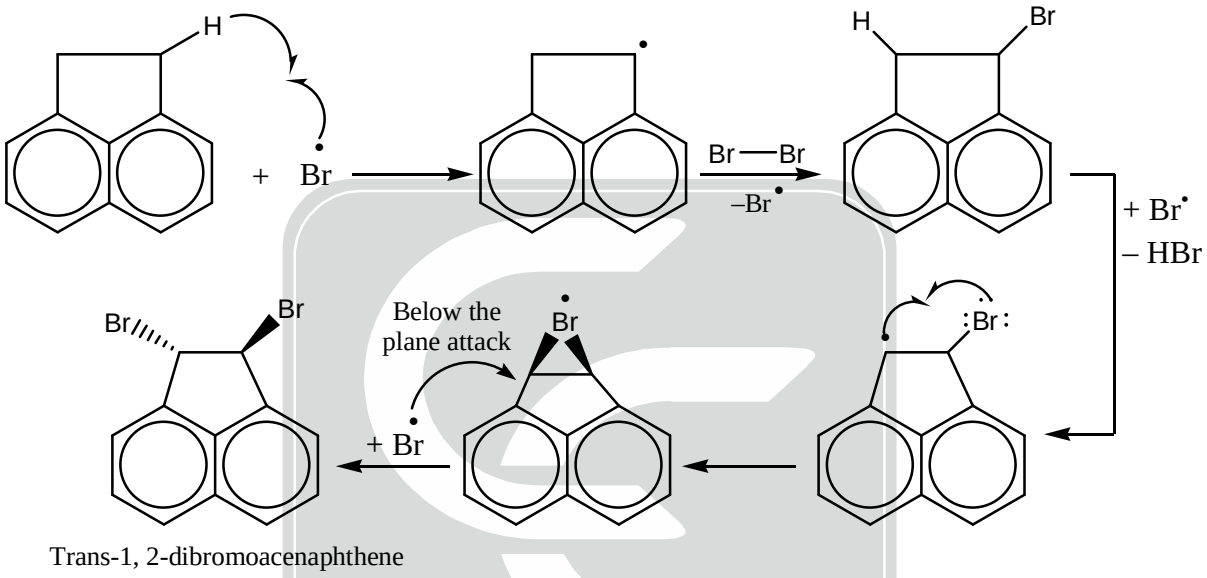
Correct option is (b)

45. 

Darzen's glycidic ester synthesis

Correct option is (c)

46. $NBS + HBr \longrightarrow Br_2 \xrightarrow{h\nu} 2Br^{\bullet}$ (Limited supply)



Trans-1, 2-dibromoacenaphthene

Correct option is (b)

47. The probability of finding the particle lies between x to $x + dx$ is given by

$$p(x)\,dx = \left(\psi(x)\right)^2 dx$$

$x = 4,\ dx = \delta$

$$P_r = |\psi|^2\, dx = \left[\sqrt{\frac{2}{\ell}}\sin\left(\frac{n\pi x}{\ell}\right)\sqrt{\frac{2}{\ell}}\sin\left(\frac{n\pi x}{\ell}\right)\right]dx$$

$$= \frac{2}{\ell}\sin^2\left(\frac{n\pi x}{\ell}\right) = \frac{2}{\ell}\sin^2\left(\frac{n\pi x}{\ell}\right) = \frac{2}{8}\sin^2\left(\frac{1\times\pi\times 4}{8}\right)\times\delta$$

$$= \frac{1}{4}\sin^2\left(\frac{\pi}{2}\right)\times\delta = \frac{\delta}{4}$$

Correct option is (a)

48. $\dfrac{d}{dx}e^{ix} = i\ e^{ix}$ therefore, eigen function

$\frac{d^2}{dx^2}e^{ix} = i^2\ e^{ix}$ therefore, eigen function

Correct option is (c)

49. In one component system 4 phases carnot simultaneously exist at single point.
Correct option is (d)

50. (i) Phase transition cannot be isoentropic

solid $\rightleftharpoons$ liquid

So, entropy is going to change during phase transition
(ii) Phase transition cannot be isochoric as

solid $\rightleftharpoons$ gas or liquid $\rightleftharpoons$ gas

Volume is going to change
(iii) Volume is going to change
As phase transition takes place at constant temperature and pressure
Correct option is (d)

51. For any cyclic process cyclic integral of state function is zero.
So, $\oint dU = 0$ as U is a state function
Correct option is (c)

52. $2\frac{a}{\sqrt{h^2+k^2+\ell^2}}\sin\theta = n\lambda \Rightarrow 2\times\frac{40}{\sqrt{5}}\times\frac{1}{2} = 1\times\lambda$

$\lambda = 18\ nm$
Correct option is (b)

53. $k = A\,e^{-\frac{\varepsilon_a}{RT}}$ at very high temperature $T \to \infty$

$k = A\,e^{-\frac{\varepsilon_a}{R\infty}} \Rightarrow k = A\,e^{-0} \Rightarrow k = \frac{A}{e^0} \Rightarrow [k = A]$

Correct option is (a)

54. As the time increases slope will decreases.
So, **correct option is (c)**

55. At equilibrium E is zero, because ΔG is zero at equilibrium.

$\Delta G = -nFE$

if $\Delta G = 0$

So, $E = 0$

Correct option is (d)

56. $1s^2, 2s^2, 2p^4$

Number of microstate for $P^4 = \frac{6!}{4!(6-4)!} = 15$

$^1s = 1\times1 = 1 \Rightarrow\ ^3p = 3\times3 = 9$

Thus, remaining microstate are 5 which comes from $^1D = 1\times5 = 5$

Correct option is (a)

57. Since, due to vibrational-rotational interaction P and R lines are obtained and molecule behave as a diatomic vibrating rotor.

$$E = BJ(J+1) + \left(\nu + \frac{1}{2}\right)\bar{\omega}_e - \left(\nu + \frac{1}{2}\right)^2 \bar{\omega}_e x_e$$

Correct option is (c)

58. Greater the surface tension, the greater the surface concentration.
Correct option is (c)

59. P.D.I. = $\frac{M_\omega}{M_n} = 1$ (for monodisperse)

$\therefore \quad \bar{M}_w = \bar{M}_n$

Correct option is (b)

60. Intermediate colours been understood and correlated to the formation of intermediate nanostructures before the formation of the final gold nanoparticles. Specifically, TEM images have shown that after few seconds of citrate addition, gold nanowires 5 to 8 nm are formed, which are responsible for the dark purple colour. Beyond a certain threshold, the nanowires disintegrate into nanoparticles, and the solution turns ruby-blue.
Correct option is (c)

PART–C

61. We have the relation between threshold energy and 'Q' of a reaction, as

$$\boxed{K_{Th} = -Q\left(\frac{M_a + M_A}{M_A}\right)}$$

Here, M_a = mass of moving projectile or bombarding particle
M_A = mass of stationary nucleus
Also, for endoergic reaction, Q > 0
Therefore, magnitude of threshold energy

$$|K_{Th}| = |-Q|\left(\frac{M_a + M_A}{M_A}\right) \quad \left[\because \quad \left(\frac{M_a + M_A}{M_A}\right) > 1\right]$$

$\therefore \quad \boxed{|K_{Th}| > |Q|}$

Correct option is (a)

62. Correct statement are
• Area of different thermal analysis peak is proportional to amount of sample
• In the thermogravimetric analysis area of curve is proportional to mass loss
• In thermogravimetric analysis two metal ion simultaneously determine.
Correct option is (b)

63. In fission of U^{235} with thermal neutrons
(1) On the average, each fission of a U^{235} nucleus produces about 2.5 free neutrons
(2) Each fission produce 200 MeV energy
(3) Fission always occure in assymmetric fashion, it means number of nuclei undergoing unsymmetrical fission is maximum.
Hence, correct statement is (1) and (3)
Correct option is (b)

64. $Bi_5^{3+} = 5\times5-3=22$

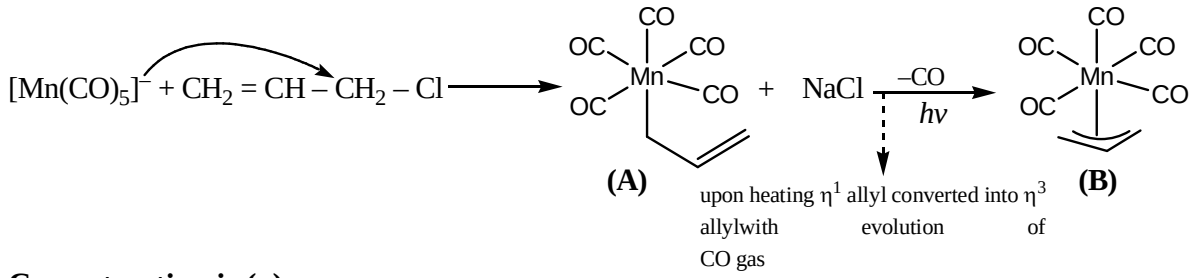
Hence, (4n + 2), closo

On addition of 2 electron it become (4n + 4), nido

Correct option is (a)

65. $Na\left[Mn(CO)_5\right] + CH_2=CH-CH_2-Cl \rightarrow$

Mechanism:



Correct option is (a)

66. $\mu_{eff} = \mu_{spin}\left(1-\frac{\alpha\lambda}{\Delta}\right)$

$$\Delta = \frac{1}{\lambda} = \frac{1}{625}\times10^{-7}\ \text{cm} = \frac{10^7}{625}\text{cm}^{-1}$$

For $Cu^{2+} \rightarrow$ Term is ^2D, hence, $\alpha = 2,\ \lambda = -625\ \text{cm}^{-1}$

$$\mu_{eff} = 1.73\left(1-\frac{2\times(-625)\ \text{cm}^{-1}}{10^7\times\text{cm}^{-1}}\times625\right) = 1.73\left(1+\frac{2\times625\times625}{10^7}\right)$$

$$= 1.73\left(1+\frac{2\times625\times625}{10^7}\right) = 1.73\{1+0.078\} = 1.73\{1.078\}$$

$$\boxed{\mu_{eff} = 1.864}$$

Correct option is (b)

67. $SbF_5 + BrF_3 \longrightarrow \left[BrF_2\right]^+ + \left[SbF_6\right]^- \rightarrow$ Lewis base behaviour of BrF_3

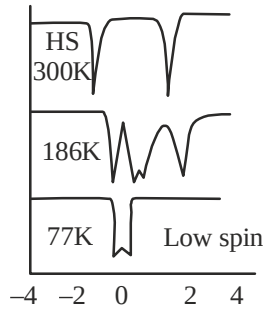
$\left[BrF_2\right]\left[SbF_6\right] + Ag\left[BrF_4\right] \rightarrow Ag\left[SbF_6\right] + 2BrF_3 \rightarrow$ Neutralization

$KF + BrF_3 \rightarrow K^+ + \left[BrF_4\right]^- \rightarrow$ Lewis acid behaviour of BrF_3

$2BrF_3 \rightarrow \left[BrF_2\right]^+ + \left[BrF_4\right]^-$ + self ionization

Correct option is (d)

68. $\left[\mathrm{Fe(1,10\text{-phenanthroline})_2(NCS)_2}\right]$



- Since NCS is ambidentate ligand therefore change in co-ordinate mode
- Change in the spin-state of iron at high temperature

Correct option is (a*)

69. $(R_3Ge)_2 \xrightarrow{hv} 2R_3Ge^{\bullet}$ in $R_3Ge^{\bullet}$ radical

multiplicity = (2NI + 1) = $2\times1\times\frac{9}{2}+1$ = 10 lines

$^{73}\mathrm{Ge}\left[\mathrm{I}=\frac{9}{2}\right]$

Correct option is (b)

70.

$^{191}\mathrm{Ir}: {}^{193}\mathrm{Ir} + {}^{35}\mathrm{Cl}: {}^{37}\mathrm{Cl}$

37% : 63% + 76% : 24%

$x \quad y \qquad a \quad b$

Natural abundance

$$(3.7x+6.3y)^1(7.6a+2.4b)^1$$

$$=3.7\times7.6xa+6.3\times7.6ya+3.7\times2.4xb+6.3\times2.4yb$$

$$=28.12\frac{xa}{M}+47.88\frac{ya}{M+2}+8.88\frac{xb}{M+2}+15.12\frac{yb}{M+4}$$

$$=28.12M+56.76(M+2)+15.12(M+4)$$

$$=28.12\times1.76M+56.76\times1.76(M+2)+15.12\times1.76(M+4)$$

$$=49.49M+100(M+2)+26.6(M+4)$$

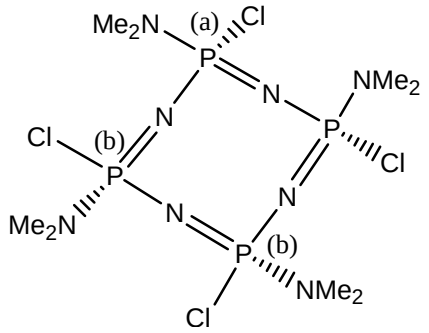
$$=49.5M+100(M+2)+26.6(M+4)$$

$M : M+2 : M+4$

49.5 : 100 : 26.6

Correct option is (a)

71.



$$^{31}P_a\left\{^1H\right\} \rightarrow (2NI+1) = \left(2\times2\times\frac{1}{2}+1\right) = 3\,(\text{triplet})$$

$$^{31}P_b\left\{^1H\right\} \rightarrow (2NI+1) = \left(2\times2\times\frac{1}{2}+1\right) = 3\,(\text{triplet})$$

Correct option is (a)

72. $[B_6H_6]^{2-}$ has 6 + 1 = 7 binding molecular orbital

$[B_6H_6]^{2-}$ $\qquad B-H = 2\times6 = 12\,e^-$

for 2 negative charge, hence $12\,e^- + 2\,e^- = 14\,e^-$

Correct option is (a)

73. N_2F_2 has two isomers,

$1C_2 + 2\sigma_v$

$1C_2 + 1\sigma_h$

Correct option is (c)

74. Metallothioneins are cystein rich, low molecular weight protein. Due to soft sulfur centre they prefer to bind.

Correct option is (b)

75. Both deoxyhemerythrin and deoxy hemocyanin are O_2 transport protein in biological system. Both contain two metal ion at active site and they bind only O_2 per active site.

Correct option is (a)

76. As the strength of ligand increases energy for d-d transition increases.

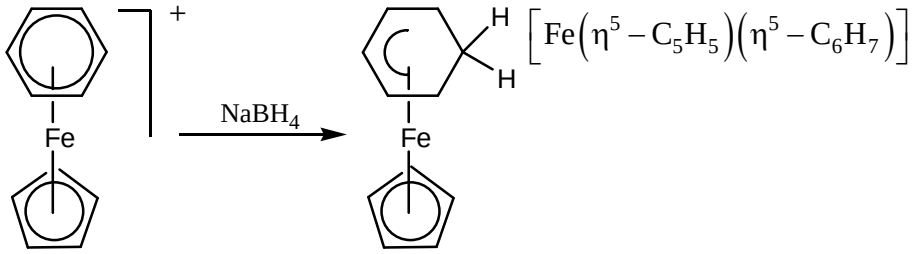
Strength of ligand order is $F^- < OX^{2-} < en$.

All complex have same number of unpaired electron. Hence, all have same spin only magnetic moment.

Correct option is (a)

76. $\left[Cr(ox)_3\right]^{3-}$ and $\left[Cr(en)_3\right]^{3+}$ will show optical isomer. As t_{2g} level is electronically non-degenerate. Hence, there will be no Jahn-Teller distortion.

Correct option is (a)

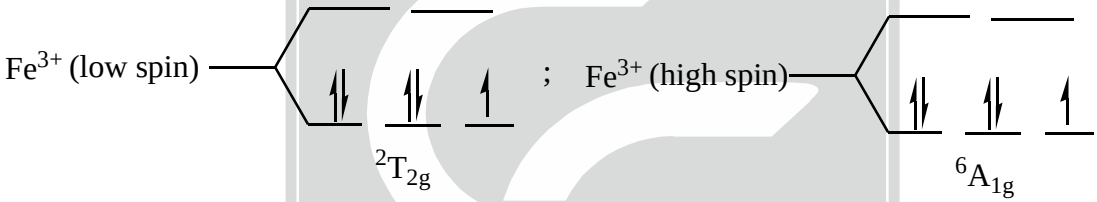
77. 

$\left[Fe(\eta^5-C_5H_5)(\eta^5-C_6H_7)\right]$

$\left[Fe(\eta^5-C_6H_6)(\eta^5-C_5H_5)\right]$

Correct option is (d)

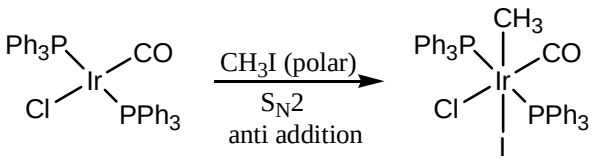
78. In $\left[Fe(S_2CNEt_2)_3\right]$ oxidation state of Fe = +3



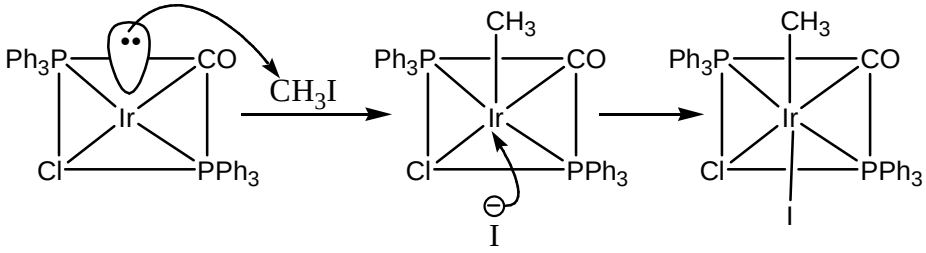
Correct option is (a)

79. $$\xrightarrow[\Delta_0 \text{ increases}]{(A)\left[Ni(H_2O)_6\right](NO_3)_2 < (B)\left[Ni(NH_3)_6\right](NO_3)_2 < (C)\left[Ni(en)_3\right](NO_3)_2}$$

Thus, order for energy absorption is 675 (A) < 615 (B) < 565 (C)
Complementary colour of blue $\rightarrow$ Orange, green $\rightarrow$ Red, Violet $\rightarrow$ Yellow
Energy order for absorbed light is, yellow > orange > red
Thus, A absorbs red hence it is green
B absorbs orange hence it is blue
C absorbs yellow hence it is violet
Thus, **correct option is (a)**

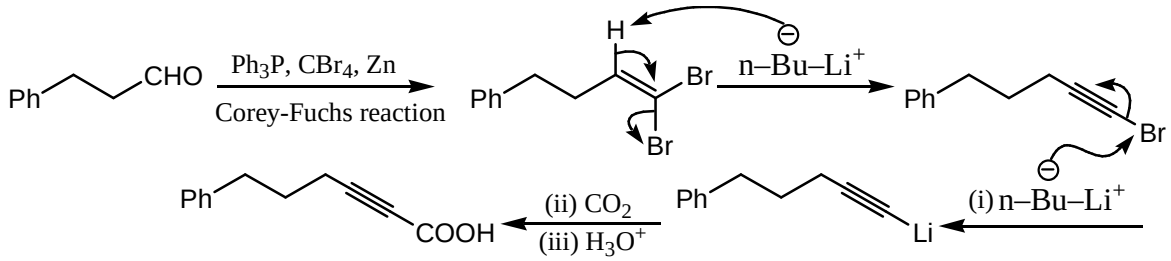
80. 

Mechanism:



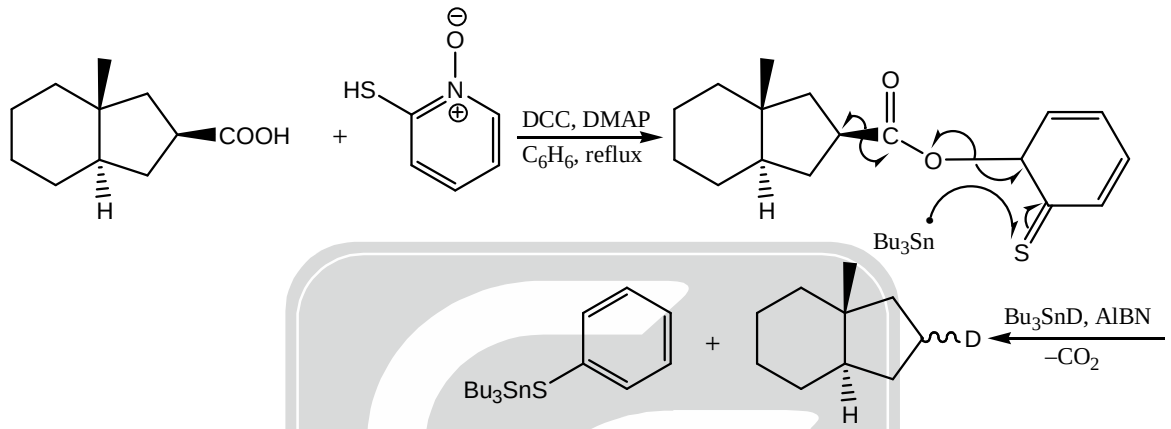
Correct option is (a)

81.



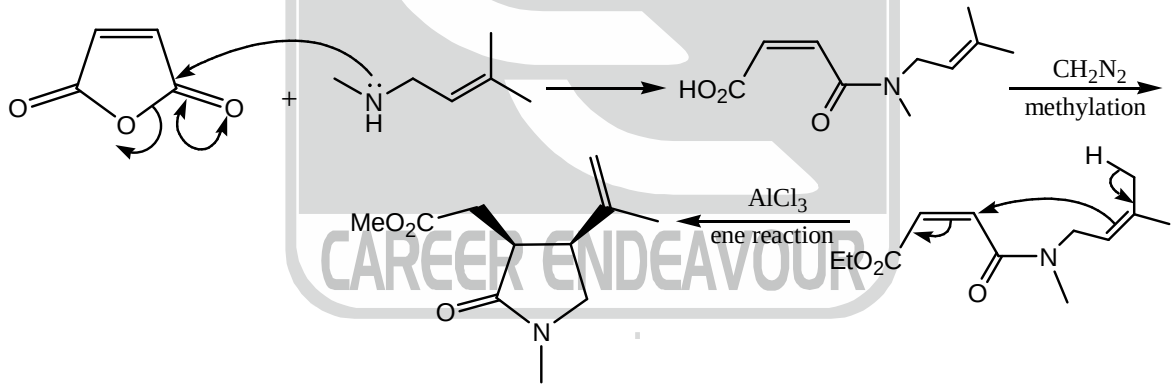
Correct option is (a)

82.



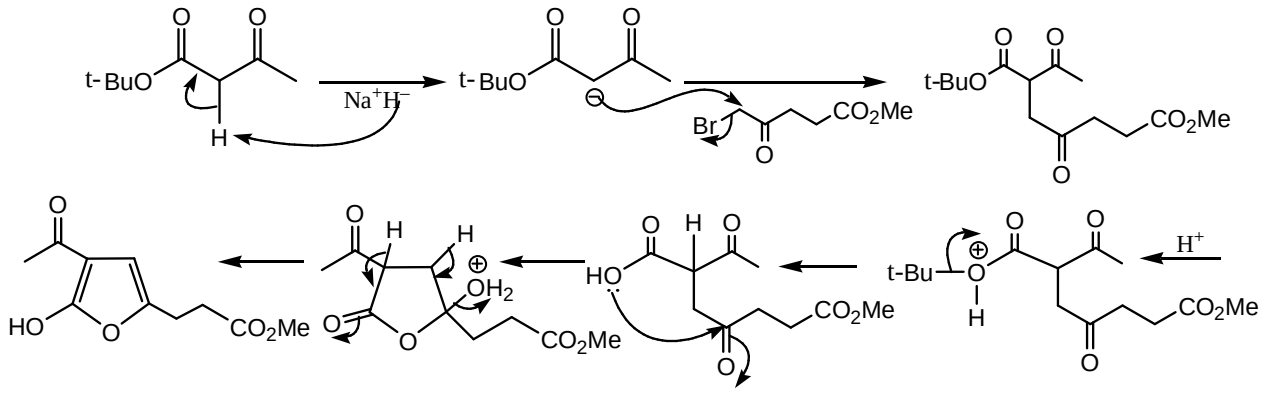
Correct option is (d)

83.

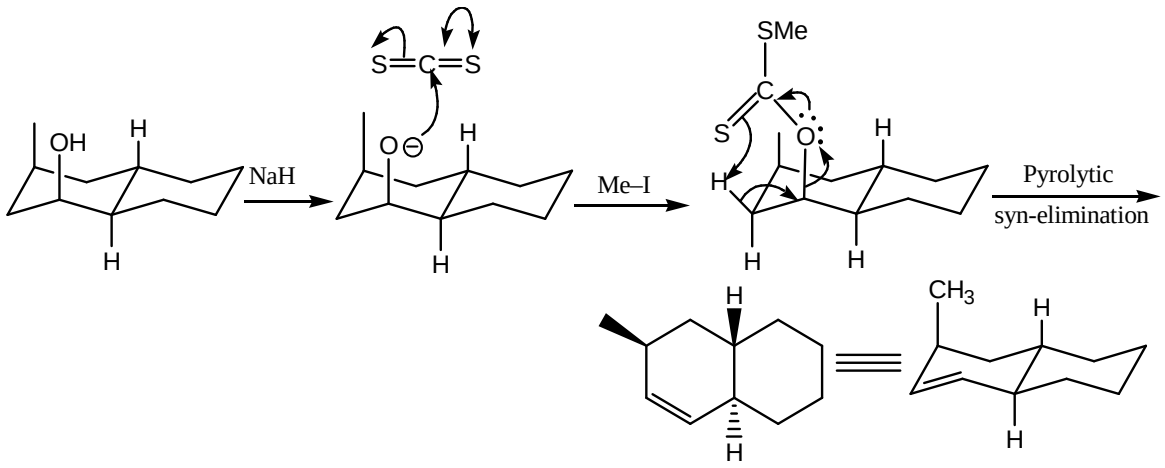


Correct option is (d)

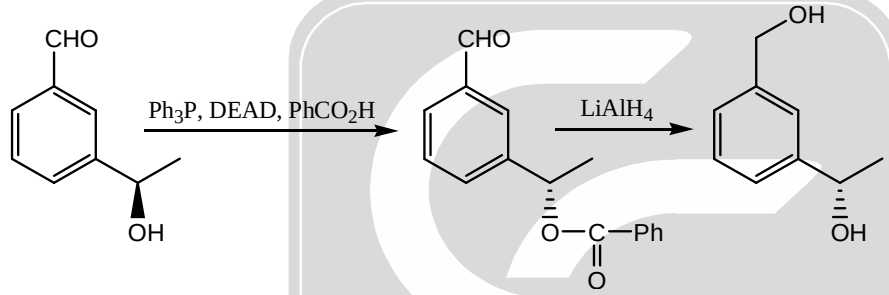
84.



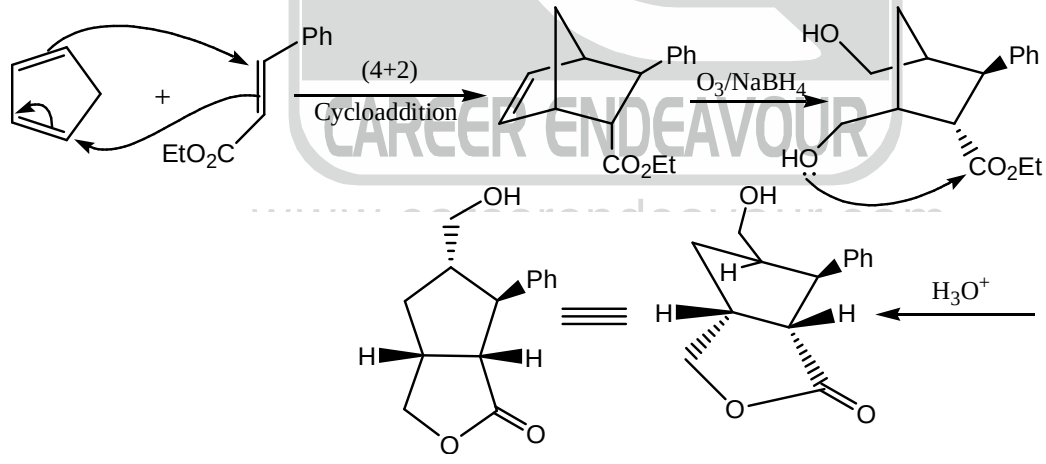
Correct option is (a)

85. 

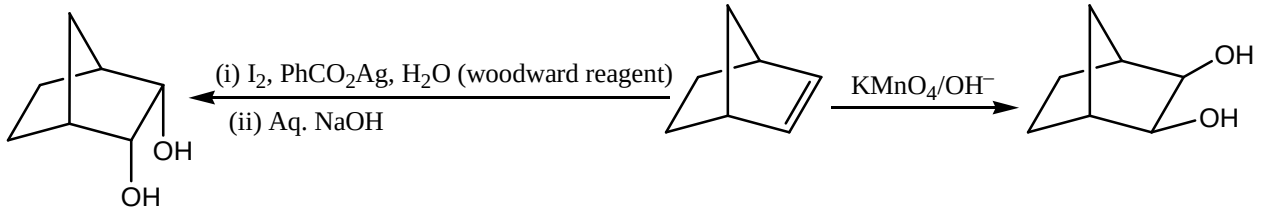
Correct option is (c)

86. 

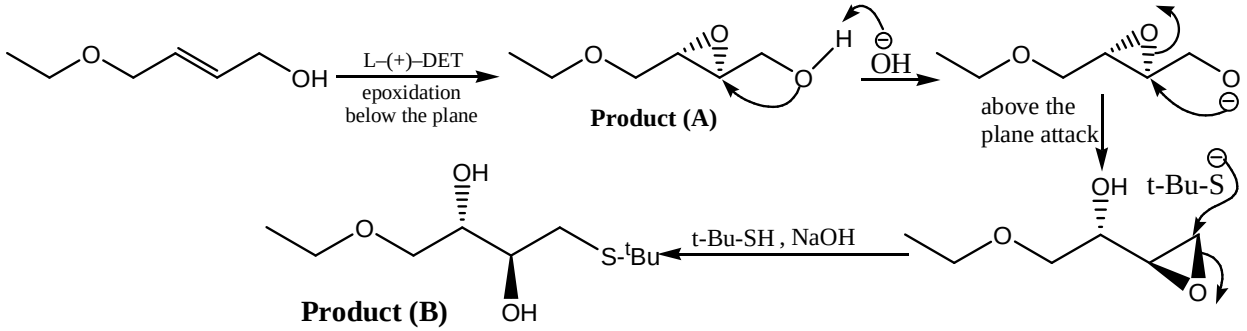
Correct option is (c)

87. 

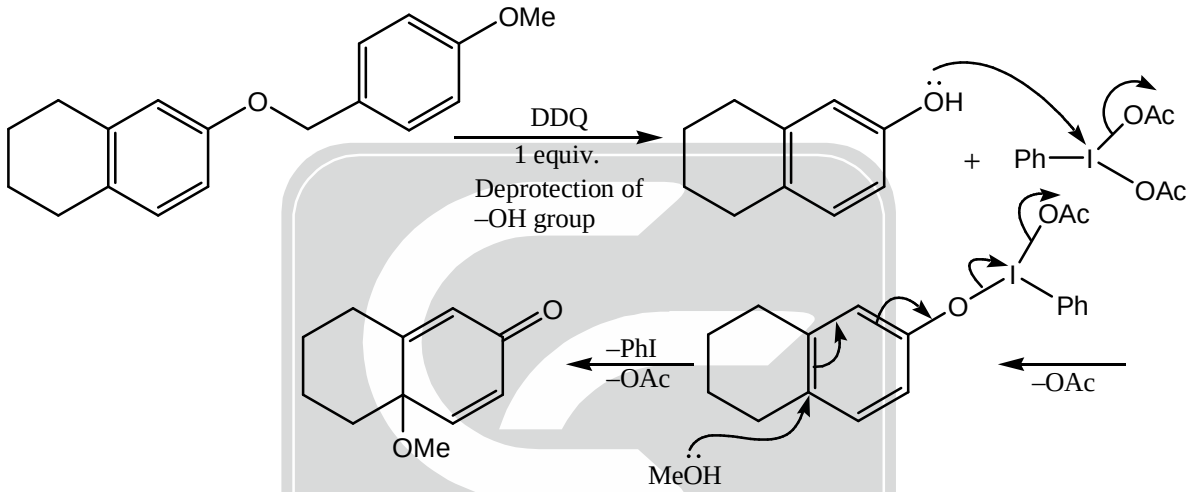
Correct option is (a)

88. 

Correct option is (b)

89. 

Correct option is (c)

90. 

Correct option is (b)

91. $[\alpha]_D$ for S–(+)–2-butanol = 10° mL/g dm

α_{obs} for mixture of R and S 2-butanol = – 0.45°

If l = 0.6 dm; C = 0.15 g/mL

$$[\alpha]_\lambda^T = \frac{\alpha}{\ell \times C} = \frac{-0.45}{0.6 \times 0.15} = -5^\circ$$

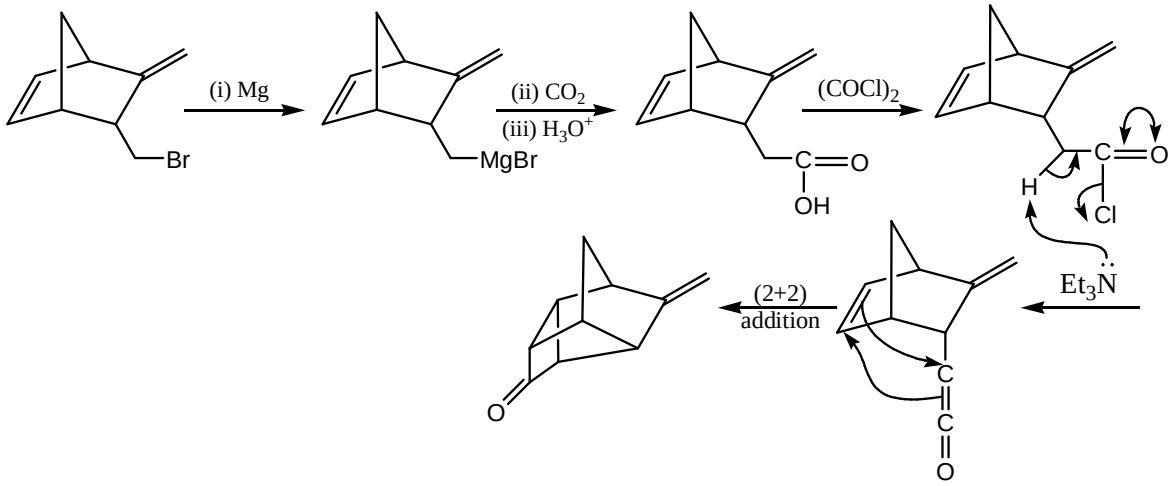
$$ee = \frac{\alpha_{mixt}}{\alpha_{\text{pure}}} = \frac{-5^\circ}{-10^\circ} \times 100 = 50\% \text{ excess of R}$$

$$R = 50 + \frac{50}{2} = 75\%$$

$$S = 25\%$$

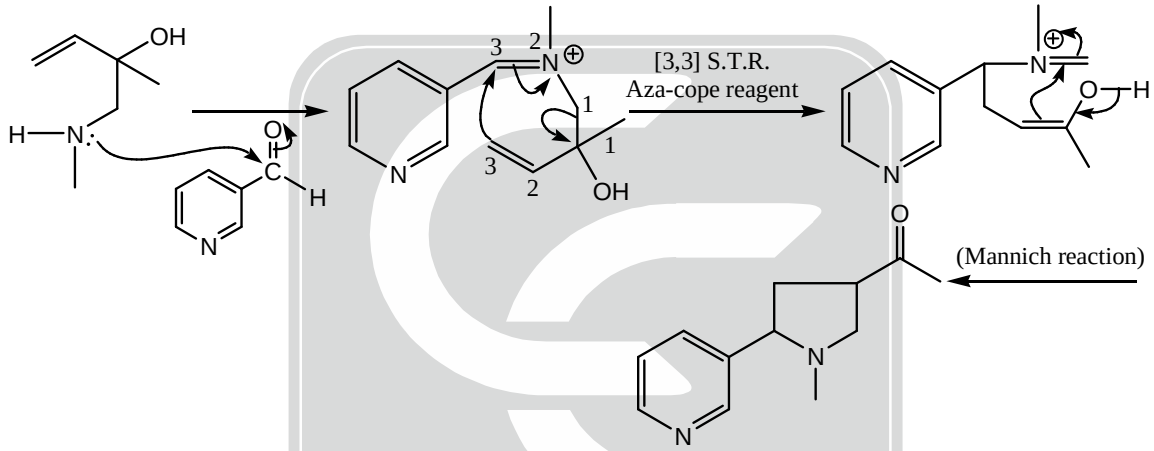
Correct option is (d)

92.



Correct option is (d)

93.



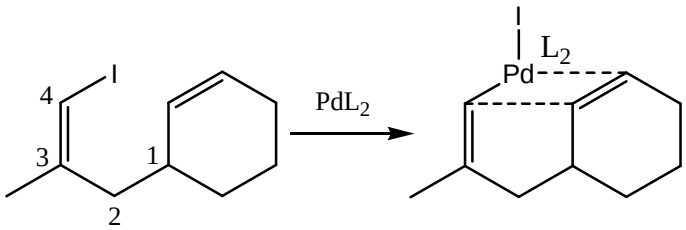
Correct option is (b)

94. $Pd(OAc)_2 + PPh_3 \longrightarrow Pd(PPh_3)_4$

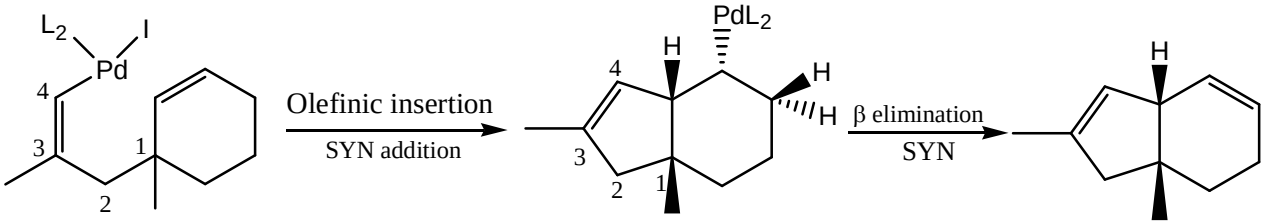
Active form is $Pd(PPh_3)_2$ or PdL_2 (where L = PPh_3)

This reaction is an example of intramolecule Heck reaction

(1) Oxidative Addition :

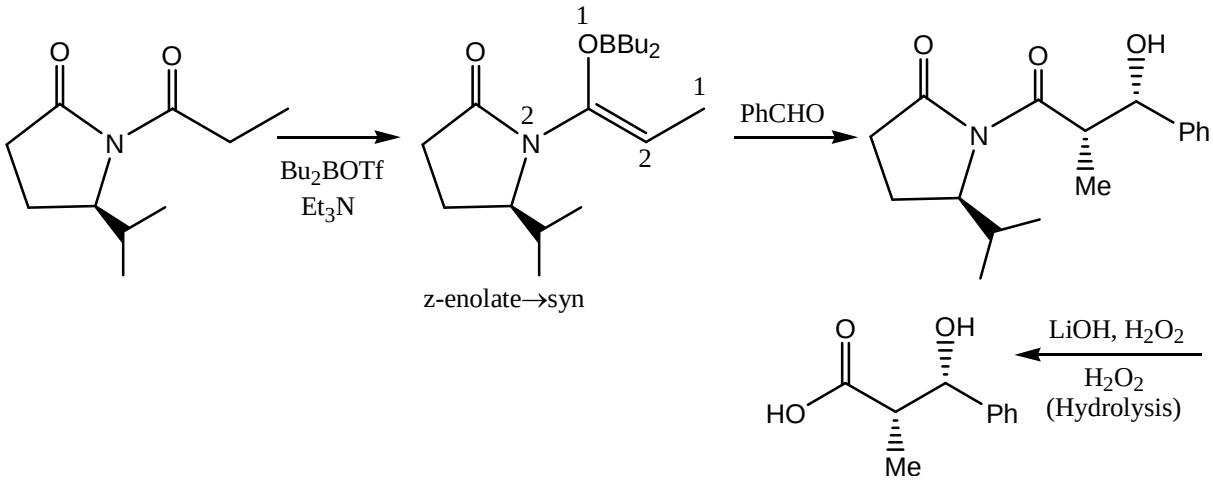


(2) Olefin insertion (Syn addition):



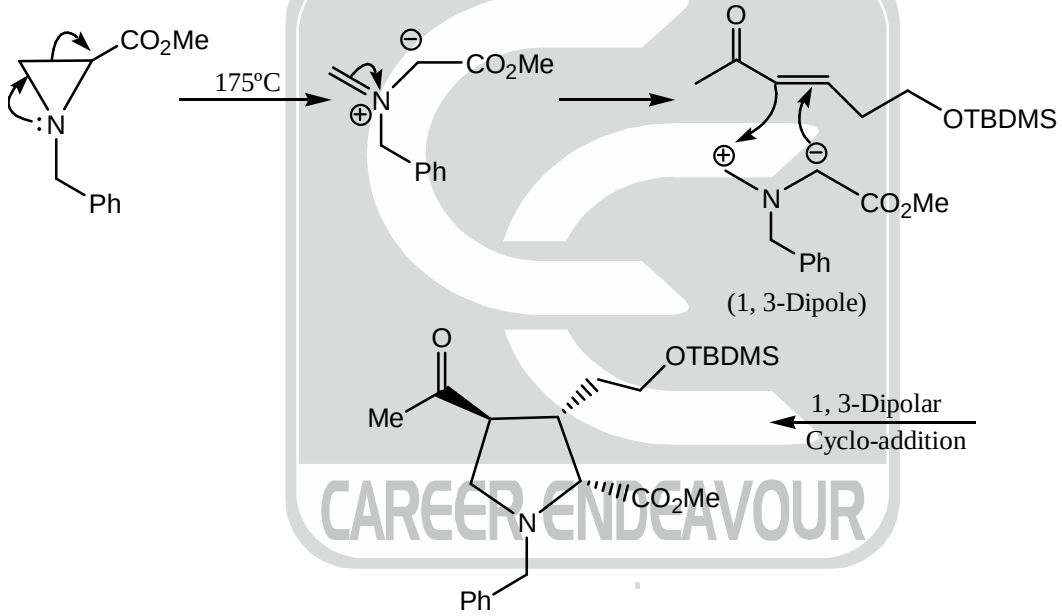
Correct option is (a)

95.



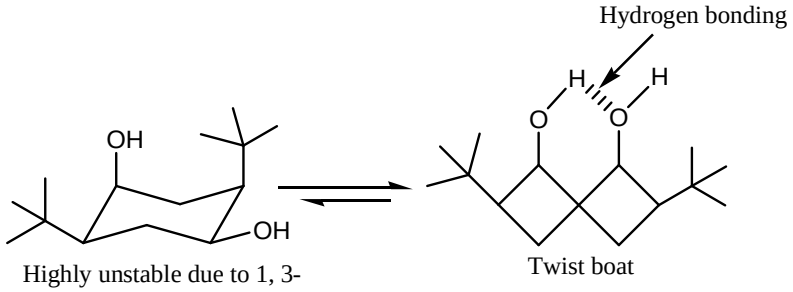
Correct option is (b)

96.



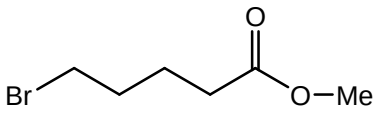
Correct option is (c)

97.



Highly unstable due to 1, 3-diaxial interaction, steric hinderance and Gauche interaction

Correct option is (c)

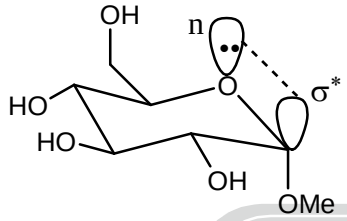
98. 

δ 3.59 $(s, 3H)$ suggest option (c) and (d)

$\left.\begin{matrix}\delta\ 3.32, t, 2H \\ 2.25, t, 2H\end{matrix}\right\}$ only possible in option (c)

Correct option is (c)

99. Anomeric effect present in compound (B)



$n \rightarrow \sigma^*$ interaction

Correct option is (c)

100. In case of RNA-uracil is present. Inspite of thymine-DNA
Correct option is (b)

101. $k = \dfrac{\theta}{1-\theta} \times \dfrac{1}{P} = \dfrac{0.1}{1-0.1} \times \dfrac{1}{25} = 0.0044$

Correct option is (b)

102. $\rho = \dfrac{Zm}{a^3}$

$$a = \left[\frac{Zm}{\rho}\right]^{1/3} = \left[\frac{1 \times 2.7 \times 10^{-22} g}{10\ gcm^{-3}}\right]^{1/3} = 3 \times 10^{-3}\ cm = 3\mathring{A}$$

And $r = \dfrac{a}{2} = 1.5\mathring{A}$

Correct option is (c)

103. $k = G \times \dfrac{\ell}{A}$

$$0.176 = G \times 0.255 \Rightarrow \frac{0.176}{0.255} = G \Rightarrow \frac{176}{255} = G$$

$0.6901\,\Omega^{-1} = G$

Correct option is (b)

104. Rate of removal of HI = $k_1[H][HI] + I_0$ ... (1)

SSA on $H^{\bullet} \Rightarrow I_a = k_1\left[H^{\bullet}\right][HI]$

Therefore, (1) $\Rightarrow r = I_a$

Correct option is (c)

105. $\gamma_{\max} = k_2 [E]_0 = 3.42\times10^4 \times 1\times10^{-2} = 3.42\times10^2 \; mol\; dm^{-3}\sec^{-1}$

And T.O.N. = $k_2 = 3.42\times10^4 \; s^{-1}$

Correct option is (a)

106. $\frac{k_1}{A_1} = e^{-E_1/RT}$ ... (1)

$\frac{k_2}{A_2} = e^{-E_2/RT}$ ... (2)

$\frac{(2)}{(1)} \Rightarrow \frac{k_2}{A_2}\times\frac{A_1}{k_1} = e^{(E_1-E_2)/RT}$

$\frac{k_2}{k_1}\frac{A_1}{A_2} > 1 \Rightarrow \frac{A_1}{A_2} > \frac{k_1}{k_2}$

Correct option is (a)

107. Fugacity of gas is less than P when attractive forces are dominant. It happens at low P and when $T < T_b$.

Correct option is (b)

108. $H_2O(g) \rightleftharpoons H_2(g) + \frac{1}{2}O_2(g)$

$P'(1-\alpha) \qquad P'\alpha \qquad \frac{P'\alpha}{2}$

$k_P = \frac{P'\alpha\cdot\left(P'\frac{\alpha}{2}\right)^{1/2}}{P'(1-\alpha)} = \frac{\alpha}{(1-\alpha)}\left(\frac{\alpha}{2}\right)^{1/2}(P')^{1/2}$

$P_T = P(1-\alpha) + P\alpha + \frac{P\alpha}{2}$

$P_T = P - P\alpha + \frac{P\alpha}{2} \Rightarrow P_T = P + \frac{P\alpha}{2} \Rightarrow P_T = P\left(1+\frac{\alpha}{2}\right) \Rightarrow P = \frac{P_T}{\left(1+\frac{\alpha}{2}\right)}$

$k_P = \frac{\alpha^{3/2}}{\sqrt{2}(1-\alpha)}\frac{P_T^{1/2}}{\left(1+\frac{\alpha}{2}\right)^{1/2}} \Rightarrow \alpha << 1 \text{ so } 1-\alpha \approx 1 \text{ and } 1+\frac{\alpha}{2} \approx 1$

$k_P = \frac{\alpha^{3/2}\; P_T^{1/2}}{\sqrt{2}}$ so $k_P \propto \alpha^{3/2}\; P_T$

Correct option is (b)

109. The given engine is working as refrigerator as it is transfering heat from sink (lower temperature) to source (higher temperature). So, efficiency of refrigerator/coefficient of performance

$$\eta' = \frac{T_1}{T_2 - T_1} = \frac{100}{300-100} = \frac{100}{200} = \frac{1}{2} \Rightarrow \eta' = \frac{\text{output}}{\text{input}} \Rightarrow \eta' = \frac{|q_c|}{\omega} \Rightarrow \frac{1}{2} = \frac{5}{\omega} \Rightarrow \omega = 10\ J$$

Correct option is (b)

110. $S_6^3 = C_6^3 \times \sigma^3 = C'_2 \times a = S_2$

Correct option is (d)

111. $\bar{M}_n = \dfrac{10 \times 20000 + 15 \times 10000}{10+15} = 14,000$

Correct option is (b)

112. $\because \quad \left(\text{no. of arrangements}\right)^{C}_{classical} > \left(\text{no. of arrangements}\right)^{A}_{fermions} > \left(\text{no. of arrangements}\right)^{B}_{bosons}$

$\Rightarrow \quad S_C > S_A > S_B$

Correct option is (d)

113. Character table of C_{3V} points group and complete table is

	E	$2C_3$	$3\sigma_v$
A_1	1	1	1
A_2	1	1	-1
E	2	-1	0

Correct option is (c)

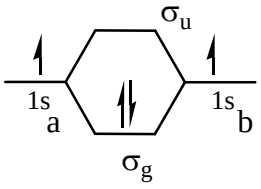
114. The given vibrational is not symmetric w.r.t. σ_h

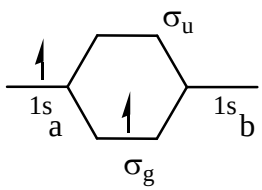
Correct option is (d)

115. $$\frac{N_2}{N} = \frac{g_2\, e^{-\beta E_2}}{g_1\, e^{-\beta E_1} + g_2\, e^{-\beta E_2}} \Rightarrow \frac{g_2\, e^{-\beta(E_2 - E_1)}}{g_1 + g_2\, e^{-\beta(E_2 - E_1)}} \quad \left\{ \frac{N_2}{N_1} = \frac{g_2}{g_1} \Rightarrow N_2 = NP_2 = \frac{N\, g_2\, e^{-E_2}}{\Sigma g_i\, e^{-\beta E_2}} \right\}$$

$$\Rightarrow \frac{2\, e^{-\frac{400}{420}}}{4 + 2\, e^{-\frac{400}{420}}} = \frac{1}{2\, e^{\frac{400}{420}} = \frac{1}{1+2e}}$$

Correct option is (d)

116. $H_2 \longrightarrow$ 

$H_2^+ \longrightarrow$ 

$_2\text{He} = 1s^2; \qquad \text{He}^+ = 1s^1$

$H_2^+: \quad r \to \infty = 1s_a(r) + 1s_b(r)$

$He^+ : \quad r \to 0 = 1s_{He}(r)$

Correct option is (d)

117. $\frac{v_p}{v_N} = \frac{g(p)}{g_{(N)}} \Rightarrow \frac{700\ MHz}{v_N} = \frac{5.6}{0.4} \Rightarrow v_N = \frac{700\ MHz \times 0.4}{5.6} = 50\ MHz$

Correct option is (d)

118. The first electronic absorption band maximum of a polar and relatively rigid aromatic molecule appears at 310 nm but its fluorescence maximum in acetonitrile solution appears with a large stokes shift at 450 nm. The reason for stokes shift increasing dipole moment of the molecule in the excited state.

Correct option (b)

119. From radial part $\left(6r - r^2\right)\exp^{-\frac{r}{3}}$

Minimum power of $r^1 = 1$

So, $\ell = 1$

Corresponding $\ell = 1$ possible angular part of eigen state is $\cos\theta$

For $\cos\theta$, $\ell = 1$

Correct option is (c)

120. $\begin{vmatrix} H_{11} - ES_{11} & H_{12} - ES_{12} \\ H_{21} - ES_{21} & H_{22} - ES_{22} \end{vmatrix} = 0$

$\begin{vmatrix} 0 - E & 2.5 \\ 2.5 & 12 - E \end{vmatrix} = 0$

$-E(12 - E) - 6.25 = 0$

$-12E + E^2 - 6.25 = 0$

$E^2 - 12E - 6.25 = 0$

The root of this equation is $E = -0.50$

$\therefore \quad E = -0.50$

Correct option is (b)