CSIR-UGC-NET (Chemical Sciences) - **15/12/2019**

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CSIR-UGC-NET Chemical Science (15-12-2019)

Q.21 – Q.60 MCQ, carry TWO marks each (for each wrong answer: –0.5).
You are required to Answer Maximum 35 Questions.

21. **Choose the correct statements for oxymyoglobin and cytochrome-P_{450} (resting state) from the following:**

[P] Both contain dianion of protoporphyrin-IX

[Q] They have same fifth-ligand bonded to metal centre from the protein backbone

[R They contain single active site

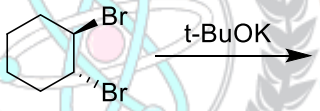
[S] They contain metal ion in +3 oxidation state

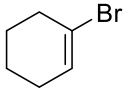
(a) P, Q and R (b) P, R and S (c) P, Q and S (d) Q and R only

22. **The hydrogen atomic orbital given by $Nr^2e^{-r/3a_0}(3\cos^2\theta - 1)$ represents**

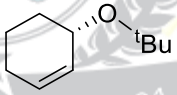
(a) 2p orbital (b) 3p orbital (c) 3d orbital (d) 4d orbital

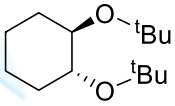
23. **The major product formed in the following reaction is**



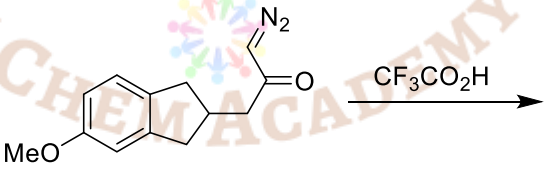
(a) 

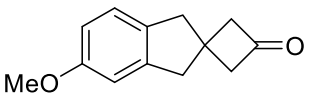
(b) 

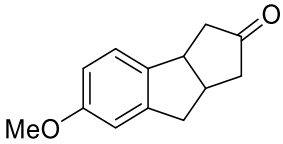
(c) 

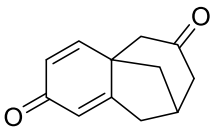
(d) 

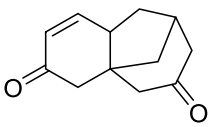
24. **The major product formed in the following reaction is**



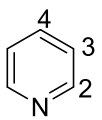
(a) 

(b) 

(c) 

(d) 

25. **The correct match of ^{13}C-NMR chemical shift values (δ ppm) for pyridine is**



	C2		C3		C4
(a)	136	;	124	;	150
(b)	124	;	150	;	136

(c) 150 ; 124 ; 136

(d) 150 ; 136 ; 124

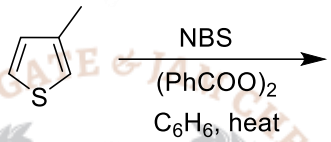
26. **The value of a physical variable was found to be 196, 198, 194, 199 and 198 in a set of five independent measurements. The average value and the standard deviation would be closest, respectively, to**

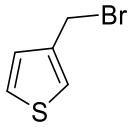
(a) 198 and 2 (b) 197 and 4 (c) 197 and 2 (d) 198 and 4

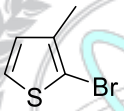
27. **The ion having the highest bond order is**

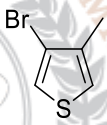
(a) NO^+ (b) O_2^+ (c) N_2^+ (d) C_2^+

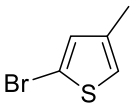
28. **The major product formed in the following reaction is**



(a) 

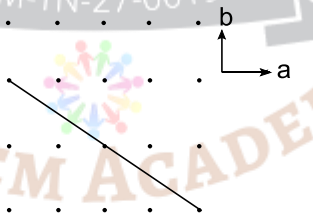
(b) 

(c) 

(d) 

29. **The expected number of ν_{CO} bands in the IR spectra of fac-$[Mo(PPh_3)_3(CO)_3]$ and trans-$[Mo(PPh_3)_2(CO)_4]$ are, respectively**

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

30. 

The Miller index for the plane as shown in the figure and parallel to the c-axis, is

(a) 110 (b) 120 (c) 210 (d) 220

31. **In IR spectrum, recorded neat, compound shows a strong and broad band at 3300 cm^{-1}. The band becomes sharp and shifts to 3600 cm^{-1} when the spectrum is recorded in CCl_4 at high dilution. This proves that the compound has**

(a) OH group, which is involved in intramolecular H-bonding

(b) OH group, which is involved in intermolecular H-bonding

(c) a terminal alkyne group

(d) OH group, present in severely sterically hindered environment

32. **Correct order of molar extinction coefficient values of the visible absorption bands for the following species is**

(a) $[Cr(H_2O)_6]^{2+}$ > $[Mn(H_2O)_6]^{2+}$ > Chlorophyll > $[NiCl_4]^{2-}$

(b) Chlorophyll > $[NiCl_4]^{2-}$ > $[Cr(H_2O)_6]^{2+}$ > $[Mn(H_2O)_6]^{2+}$

(c) $[NiCl_4]^{2-}$ > Chlorophyll > $[Cr(H_2O)_6]^{2+}$ > $[Mn(H_2O)_6]^{2+}$

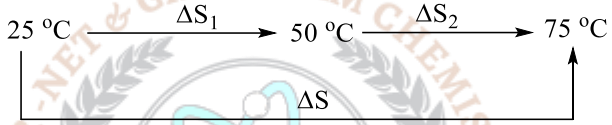
(d) Chlorophyll > $[Cr(H_2O)_6]^{2+}$ > $[NiCl_4]^{2-}$ > $[Mn(H_2O)_6]^{2+}$

33. **The cell potential (in V) of Ag/AgCl/KCl electrode connected to the standard hydrogen electrode at 298 K is closest to**

(Given $E^{\circ}_{(AgCl/Ag,Cl^-)} = 0.222$ V and assume that the activity of KCl is 0.01)

(a) 0.197 (b) 0.297 (c) 0.340 (d) 0.440

34. **Consider the entropy changes in a system undergoing transformation, as depicted in the diagram below**



The correct statement among the following is

(a) $\Delta S_1 = \Delta S_2$ and $\Delta S \neq \Delta S_1 + \Delta S_2$ (b) $\Delta S_1 > \Delta S_2$ and $\Delta S \neq \Delta S_1 + \Delta S_2$

(c) $\Delta S_1 = \Delta S_2$ and $\Delta S = \Delta S_1 + \Delta S_2$ (d) $\Delta S_1 > \Delta S_2$ and $\Delta S = \Delta S_1 + \Delta S_2$

35. **Consider four species P, Q, R and S.**

$$P + Q \xrightarrow{KI,\ H^+} R$$

Oxidation of P with R in an acidic medium gives S. P, Q, R and S are, respectively

	P		Q		R		S
(a)	$S_4O_6^{2-}$	;	I_2	;	KIO_3	and	SO_4^{2-}
(b)	$S_4O_6^{2-}$	;	KIO_3	;	I_2	and	SO_4^{2-}
(c)	$S_2O_3^{2-}$	;	KIO_3	;	I_2	and	$S_4O_6^{2-}$
(d)	$S_2O_3^{2-}$	;	KIO_3	;	I_2	and	SO_4^{2-}

36. **The common hapticity observed for coordination of C_{60} to a metal center is**

(a) 2 (b) 4 (c) 5 (d) 6

37. **For an octahedral Cu^{2+} complex depicting axial EPR spectrum $(g_{\parallel} > g_{\perp})$, the geometry of Cu^{2+} and the orbital containing the unpaired electron are, respectively**

(a) Tetragonally elongated, $d_{x^2-y^2}$ (b) Tetragonally compressed, d_{z^2}

(c) Tetragonally elongated, d_{z^2} (d) Tetragonally compressed, $d_{x^2-y^2}$

38. **A liquid of density $1.1\ g\ cm^{-3}$ climbs to a height of 5.0 cm when a capillary with**

internal radius of 0.2 mm is dipped into it. The surface tension (in Nm^{-1}) of the liquid is closest to

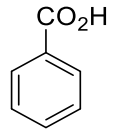
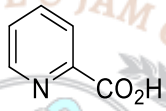
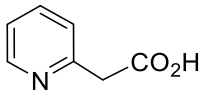
(a) 0.05 (b) 0.108 (c) 0.018 (d) 0.005

39. **Identify from following, the product(s) of K-electron capture by the nucleus is/are:**

P	Q	Q
neutron	neutrino	positron

(a) P only (b) P and Q (c) R only (d) Q and R

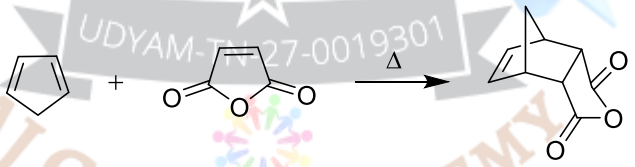
40. **The correct order for the rate of thermal decarboxylation of the following compounds is**

P	Q	R
		

(a) R > Q > P (b) R > P > Q

(c) P > R > Q (d) Q > R > P

41. **TRUE statement for the following transformation is**



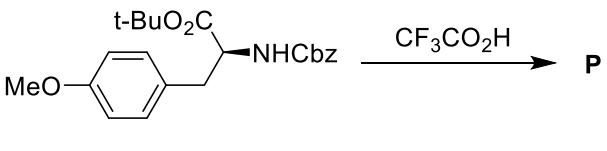
(a) $\Delta H°$ and $\Delta S°$ are positive (b) $\Delta H°$ and $\Delta S°$ are negative

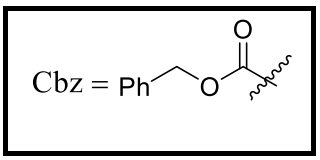
(c) $\Delta H°$ is positive and $\Delta S°$ is negative (d) $\Delta H°$ is negative and $\Delta S°$ is positive

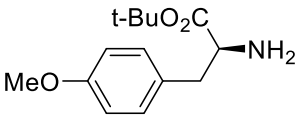
42. **The most stable vanadium species in aqueous medium is**

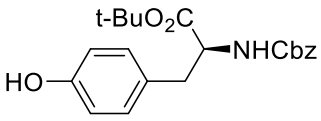
(a) $[V(H_2O)_5(OH)]^{2+}$ (b) $[VO(H_2O)_5]^{2+}$ (c) $[VO(H_2O)_5]^{+}$ (d) $[V(H_2O)_4(OH)_2]^{2+}$

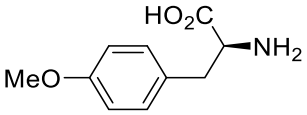
43. **The major product formed in the following reaction is**

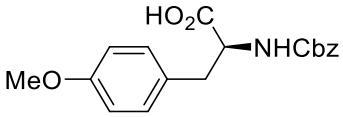




(a) 

(b) 

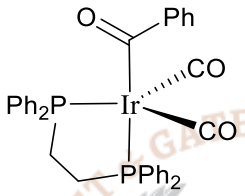
(c) 

(d) 

44. **The frequency of O–H of stretch occurs at $\sim 3600\ cm^{-1}$. The O–D stretch frequency (cm^{-1}) would be closest to**

(a) 3000 (b) 2600 (c) 1800 (d) 900

45. **For the complex shown below in non-fluxional state, the expected $^{31}P\{^{1}H\}$-NMR resonance(s) is/are [^{31}P: I = ½]**



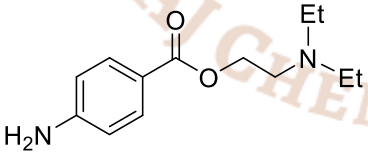
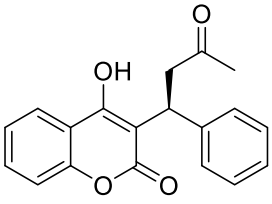
(a) one singlet
(b) one doublet
(c) two singlets
(d) two doublets

46. **If the rate constant for a base catalysed ester hydrolysis reaction is $0.20\ L\ mol^{-1}s^{-1}$, half-life (in s) of the ester would be closest to**

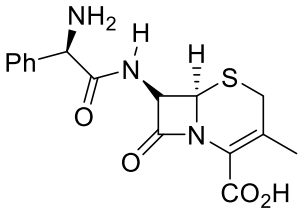
(Given: $[ester]_o = [base]_o = 0.05\ mol.L^{-1}$)

(a) 40 (b) 100 (c) 140 (d) 200

47. **The correct match for the drug molecules in the Column-I with their medicinal use in column-II is**

	Column-I		Column-II
P.	 **Procaine**	i.	**Anaesthetic**
Q.	 **Warfarin**	ii.	**Anticoagulant**

	P		Q		R
(a)	i	;	ii	;	iii
(b)	ii	;	i	;	iii
(c)	iii	;	i	;	ii
(d)	i	;	iii	;	ii

R.	 **Cephalexin**	**iii.**	**Antibiotic**

48. **Molar composition of a mixture of P and Q at equilibrium is 3 : 1 (P : Q). A small disturbance in composition results in change of chemical potential of P by 10 J mol^{-1}. The chemical potential of Q will change (in J mol^{-1}) by:**

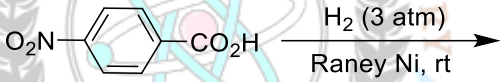
(a) 30 (b) 3.3 (c) -30 (d) -3.3

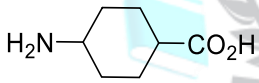
49. **The magnitude of bond angles in gaseous NF_3, SbF_3 and $SbCl_3$, follow the order**

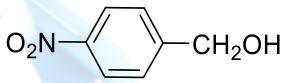
(a) $NF_3 > SbF_3 > SbCl_3$ (b) $SbCl_3 > SbF_3 > NF_3$

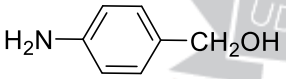
(c) $SbF_3 > SbCl_3 > NF_3$ (d) $NF_3 > SbCl_3 > SbF_3$

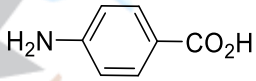
50. **The major product formed in the following reaction is**



(a) 

(b) 

(c) 

(d) 

51. **A cube does not have the symmetry element**

(a) C_2 (b) C_3 (c) C_4 (d) C_6

52. **The pair of light source and atomizer resulting highest sensitivity to atomic absorption spectrometric measurement is**

(a) Hg lamp; nitric oxide flame

(b) Hg lamp; graphite furnace

(c) Hollow cathode lamp; graphite furnace

(d) Hollow cathode lamp; acetylene-nitric oxide flame

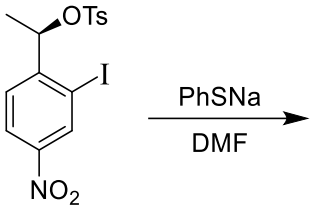
53. **In common glass electrode, alkaline error caused at pH > 10 is least for**

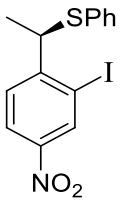
(a) 0.01 M NaCl (b) 1.0 M NaCl (c) 1.0 M LiCl (d) 1.0 M KCl

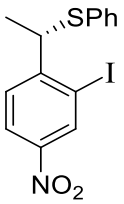
54. **Pair of lanthanide ions which show significant deviation between the experimental and calculated magnetic moments, considering contribution from the ground state only is** **(given $\mu_{eff} = g\,[J(J+1)]^{1/2}$)**

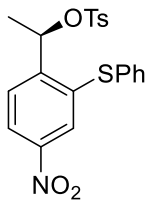
(a) Gd^{3+} and Lu^{3+} (b) Sm^{3+} and Tb^{3+} (c) Eu^{3+} and Tb^{3+} (d) Sm^{3+} and Eu^{3+}

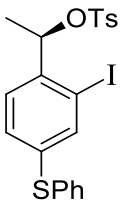
55. **The major product formed in the following reaction is**



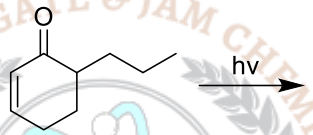
(a) 

(b) 

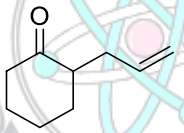
(c) 

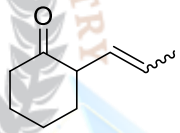
(d) 

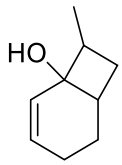
56. **The major product formed in the following reaction is**



(a) 

(b) 

(c) 

(d) 

57. **E1cb mechanism is followed in the reaction of**

(a) 2-bromopentane with t-BuOK to give pent-2-ene

(b) nitromethane with benzaldehyde in the presence of KOH to give β-nitrostyrene

(c) bromobenzene with $NaNH_2$ to give aniline

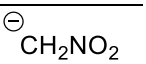
(d) p-chloronitrobenzene with NaOMe to give p-nitroanisole

58. **Consider a two-level system in which the excited state, separated from the ground state by energy ε, is doubly degenerate. The fraction of the molecules in the excited state, as $T \to \infty$, is**

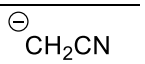
(a) $\frac{1}{3}$ (b) $\frac{1}{2}$ (c) $\frac{2}{3}$ (d) 1

59. **The correct order of basicity of the following anions is**

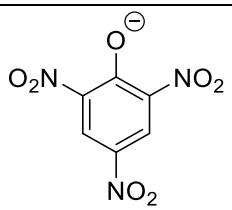
P



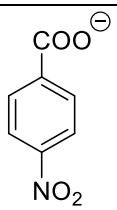
Q



R



S



(a) Q > P > R > S (b) S > Q > R > P

(c) R > S > Q > P (d) Q > P > S > R

60. **The titration of 4.4 g of a polymer having carboxylic acid end group requires 11 mL of 0.02 M NaOH. The average molar mass (in kg mol^{-1}) of the polymer is**

(a) 40 (b) 20 (c) 15 (d) 10

Q.61 – Q.120 MCQ, carry FOUR marks each (for each wrong answer: –1).
You are required to Answer Maximum 25 Questions.

61. **The rate-determining step in the catalytic synthesis of acetic acid by Monsanto process is**

(a) oxidative addition of CH_3I to $[RhI_2(CO)_2]^-$

(b) migration of CH_3 group to CO of $[RhI_3(CO)_2(CH_3)]^-$

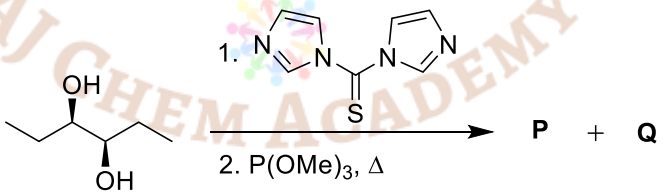
(c) loss of CH_3COI from $[RhI_3(CO)_2(COCH_3)]^-$

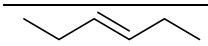
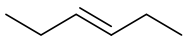
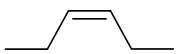
(d) coordination of CO to $[RhI_3CO(COCH_3)]^-$

62. **The rate constant of a second order reaction $2A \longrightarrow Z$ is k_2. If the initial concentration of the reactant is a_o and the concentration of the product at time t is x, then a linear function of t with the slope k_2a_o is**

(a) $\ln\left(\frac{x}{a_0-x}\right)$ (b) $\frac{x}{a_0(a_0-x)}$ (c) $\frac{x}{a_0-x}$ (d) $\ln\left(\frac{x}{a_0(a_0-x)}\right)$

63. **The major product P and the by-products Q formed in the following reaction are**



	P	Q
(a)		CO_2, $S{=}P(OMe)_3$
(b)		$O{=}C{=}S$, $O{=}P(OMe)_3$
(c)		CO_2, $S{=}P(OMe)_3$
(d)		$O{=}C{=}S$, $O{=}P(OMe)_3$

64. **Choose the equilibria from the following that are NOT favoured to go to right**

[P] $As_2S_5 + 5\ HgO \rightleftharpoons As_2O_5 + 5\ HgS$

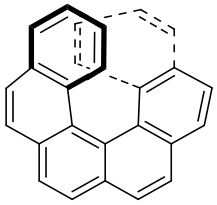
[Q] $La_2(CO_3)_3 + Bi_2S_3 \rightleftharpoons La_2S_3 + Bi_2(CO_3)_3$

[R] $CdSO_4 + CaS \rightleftharpoons CdS + CaSO_4$

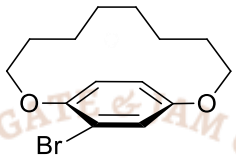
[S] $BeF_2 + HgI_2 \rightleftharpoons BeI_2 + HgF_2$

(a) P and Q (b) P and R (c) Q and R (d) Q and S

65. **The correct absolute configuration of the following compounds is**



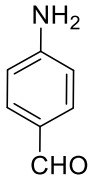
I

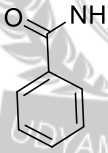


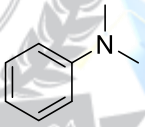
II

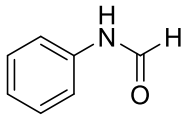
	I		II
(a)	M	;	R
(b)	M	;	S
(c)	P	;	R
(d)	P	;	S

66. **The compound that shows peaks in the EI mass spectrum at m/z 121, 105, 77, 44 is**

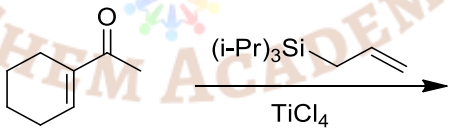
(a) 

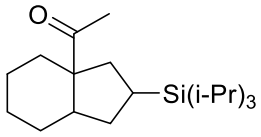
(b) 

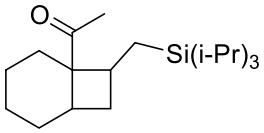
(c) 

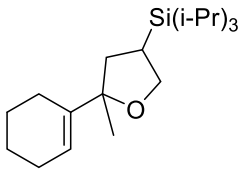
(d) 

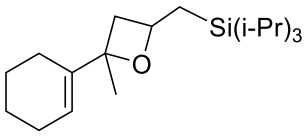
67. **The major product formed in the following reaction is**



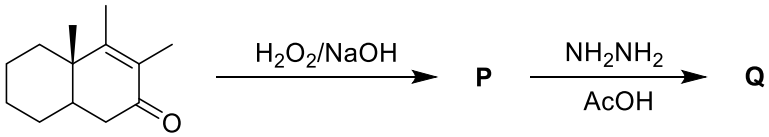
(a) 

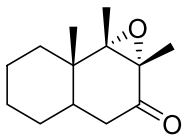
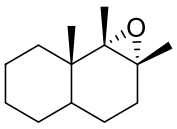
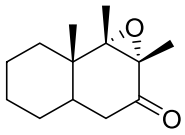
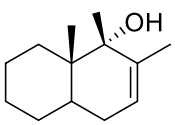
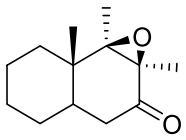
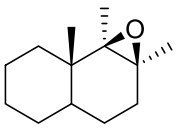
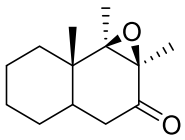
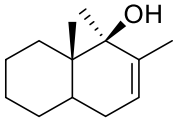
(b) 

(c) 

(d) 

68. **The major products P and Q in the following reaction sequence are**



	P	Q
(a)		
(b)		
(c)		
(d)		

69. **Match the items in Column I with those of Column II**

	Column-I (species)		Column-II (structure/properties)
P.	NaH	i.	polymeric chain
Q.	BeH_2	ii.	interstitial hydride
R.	$HfH_{2.10}$	iii.	tricapped trigonal prismatic
S.	$[TcH_9]^{2-}$	iv.	saline hydride

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

70. **The degeneracy of the state having energy $\frac{27h^2}{8mL^2}$ for a particle in a 3-D cubic box of length L is**

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

71. **The spatial part of the dominant resonance structure of the LiH molecule is (only valance part of the wavefunction is shown)**

(a) $2s_{Li}(r_1)2s_{Li}(r_2)$ (b) $2s_{Li}(r_1)1s_H(r_2) + 2s_{Li}(r_2)1s_H(r_1)$

(c) $2s_{Li}(r_1)1s_H(r_2) - 2s_{Li}(r_2)1s_H(r_1)$ (d) $1s_H(r_1)1s_H(r_2)$

72. **$FeCr_2O_4$ and $NiGa_2O_4$ have normal and inverse spinel structures, respectively. The correct statement is**

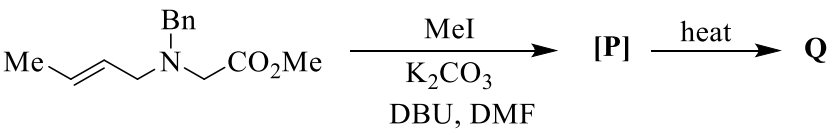
(a) Fe(II) and Ni(II) occupy octahedral sites

(b) Fe(II) and Ni(II) occupy tetrahedral an octahedral sites, respectively

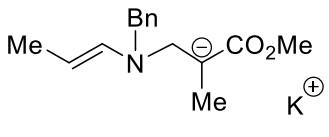
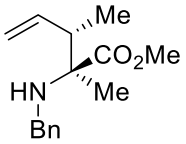
(c) Cr(III) and Ga (III) occupy only octahedral sites

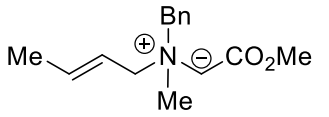
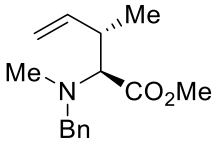
(d) Cr(III) and Ga(III) occupy tetrahedral and octahedral sites, respectively

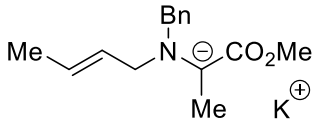
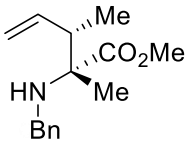
73. **The intermediate [P] and the major product Q formed in the following reaction are**

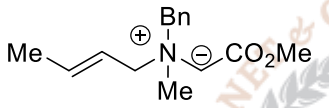
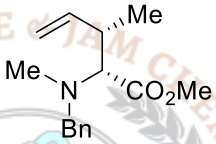


[P]	Q

(a)  ; 

(b)  ; 

(c)  ; 

(d)  ; 

74. **The cluster types of $[Fe_5(CO)_{14}N]^-$ and $[Co_6(CO)_{13}N]^-$ are respectively**

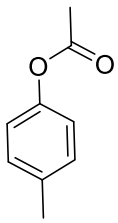
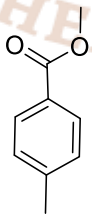
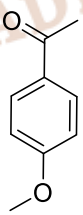
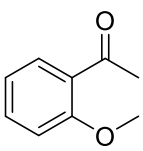
(a) nido & nido (b) nido & closo (c) closo & nido (d) closo & closo

75. **The structure of the compound, which displays the following spectral data is**

IR : $1690, 1110\ cm^{-1}$

^{1}H-NMR : $2.8\ (s, 3H), 3.8\ (s, 3H), 6.9\ (d, J = 8\ Hz, 2H), 7.8\ (d, = 8\ Hz, 2H)$

^{13}C -NMR : $197, 165, 130, 129, 114, 56, 26$

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

76. **The species for which the shapes (geometry) can be predicted by VSEPR theory is/are,**

P	Q	R
$[PtCl_4]^{2-}$	$[TeCl_6]^{2-}$	PF_3 and SF_6

(a) P and R (b) Q and R (c) R only (d) P and Q

77. **The correct statement about base hydrolysis of $[Co(py)_4Cl_2]^+$, (py = pyridine) is**

(a) rate expression is, Rate $= k[Co(py)_4Cl_2]^+[OH^-]$

(b) reaction does not depend on hydroxide ion concentration

(c) reaction proceeds through S_N1CB mechanism

(d) intermediate involved in this reaction is $[Co(py)_4Cl_2(OH)]$

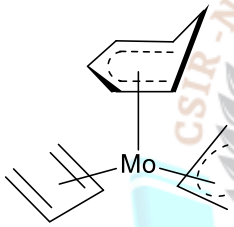
78. **Complex(es) which has/have unpaired electron(s) that is equal to that of iron center in oxymyoglobin is/are** **(Given: ox = oxalato)**

P	Q	R	S
$[Fe(ox)_3]^{3-}$	$[Fe(CN)_6]^{3-}$	$[NiCl_4]^{2-}$	$[Cu(NH_3)_4]^{2+}$

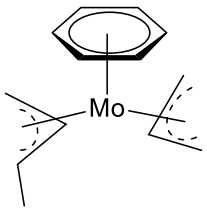
(a) P and Q (b) Q and S (c) R only (d) R and S

79. **The main product of nucleophilic attack of H^- on the complex ion given below is**

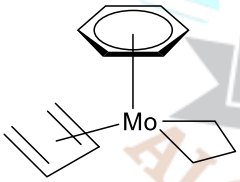
(a)



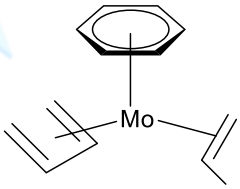
(b)



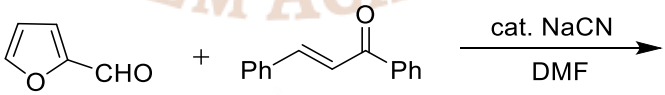
(c)



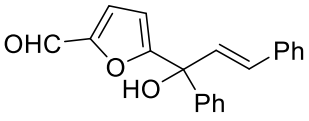
(d)



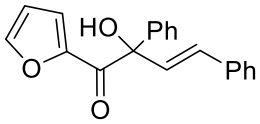
80. **The major product formed in the following reaction is**



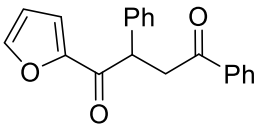
(a)



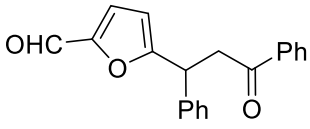
(b)



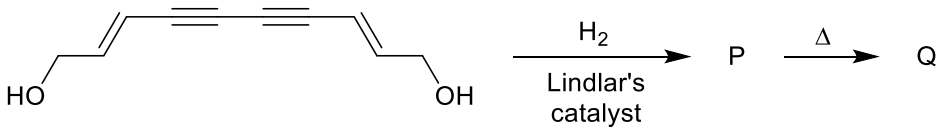
(c)

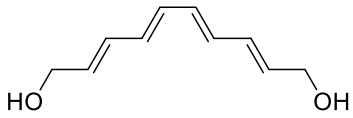
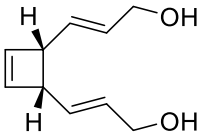
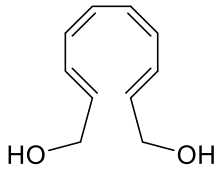
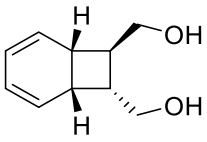
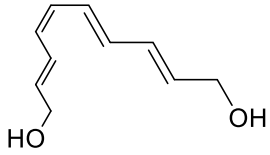
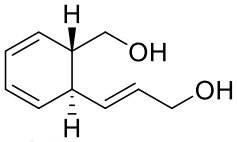
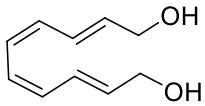
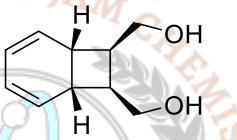


(d)



81. **The intermediate P and the major product Q formed in the following reaction are**



	P	Q
(a)		
(b)		
(c)		
(d)		

82. **Consider the gas phase reaction $2A_{(g)} + 3B_{(g)} \rightleftharpoons 2C_{(g)}$ at a given temperature. When 2.0 moles of $A_{(g)}$ are reacted with 2.0 moles of $B_{(g)}$, 0.8 moles of $C_{(g)}$ are formed at equilibrium at a total pressure of 2.0 bar. The value of the equilibrium constant, K_P of this reaction at the given temperature is closest to**

(a) 0.3 (b) 0.9 (c) 2.4 (d) 19.1

83. **In a polymer of N monomer units, the root mean square separation between the two ends is proportional to**

(a) $N^{\frac{1}{2}}$ (b) N (c) $N^{\frac{3}{2}}$ (d) N^2

84. **For the electrochemical cell $Ag|AgCl|MCl(0.01M)|MCl(0.02M)|AgCl|Ag$, the junction potential is the highest when M^+ is**

(a) H^+ (b) Li^+ (c) Na^+ (d) K^+

85. **The function, which is NOT an eigen function of the indicated operator, is**

	Operator		Function
(a)	$\frac{d^2}{dx^2} - x^2$	:	$e^{-x^2/2}$
(b)	$\frac{d^2}{dx^2} + x^2$	:	$e^{-x^2/2}$
(c)	$\frac{d^2}{dx^2}$	:	$\cos\frac{\pi x}{4}$
(d)	$\frac{d^2}{dx^2}$	:	e^{4ix}

86. **The oxidation of NO to NO_2 occurs via the mechanism given below.**

$$2NO \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} N_2O_2 \xrightarrow[O_2]{k_2} 2NO_2$$

$\frac{d[NO_2]}{dt}$ **in the presence of large excess of** O_2 **can be written as**

(a) $2k_1(NO)^2$ (b) $2k_1k_2(NO)^2(O_2)$ (c) $\frac{k_1}{k_2}(NO)^2$ (d) $2k_2(NO)^2$

87. **Among** $SO_2(OH)F, CH_3CO_2H, LiF$ **and** H_2O **the compound(s) which behave(s) as a base in liquid HF is/are**

(a) CH_3CO_2H and LiF only (b) LiF only

(c) $SO_2(OH)F$ and LiF only (d) CH_3CO_2H, LiF and H_2O

88. **The reducible representation(Γ), in the table is equal to the following superposition of the irreducible representations of** C_{2v} **point group**

C_{2v}	E	C_2	σ_v	σ'_v
A_1	1	1	1	1
A_2	1	1	–1	–1
B_1	1	–1	1	–1
B_2	1	–1	–1	1
Γ	8	–2	–6	4

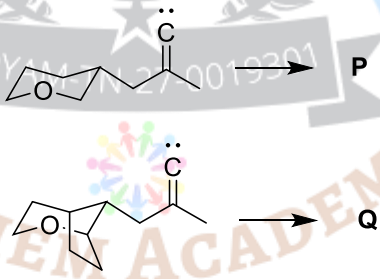
(a) $A_1 \oplus 2A_2 \oplus 5B_1$

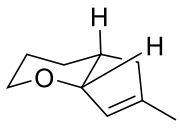
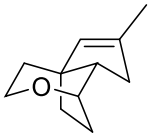
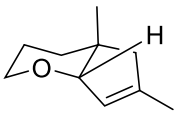
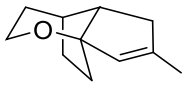
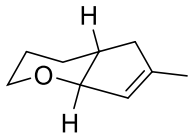
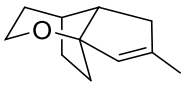
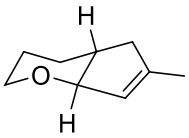
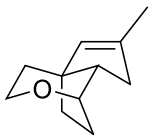
(b) $A_1 \oplus 2A_2 \oplus 5B_2$

(c) $5A_1 \oplus A_2 \oplus 2B_1$

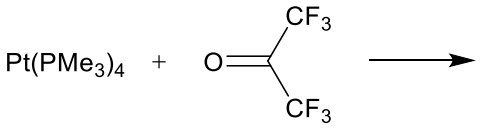
(d) $A_1 \oplus 5A_2 \oplus 2B_2$

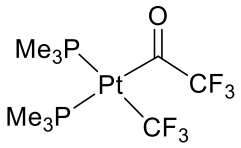
89. **Products P and Q formed in the transformation of alkylidenecarbenes are**

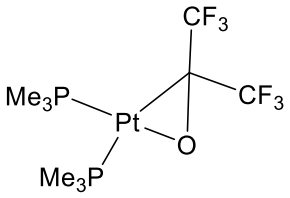


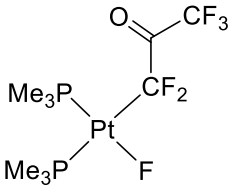
	P	Q		P	Q
(a)			(b)		
(c)			(d)		

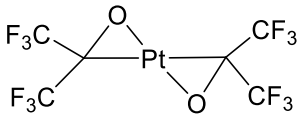
90. **The major product of the following reaction is**



(a) 

(b) 

(c) 

(d) 

91. **In Mossbauer spectrum of a sample containing iron recorded in the presence of a static magnetic field, the number of possible allowed transition(s) is**

(a) Two (b) Four (c) Six (d) Eight

92. **Match Column I, II and III**

	Column-I (metal)		Column-II (enzyme)		Column-III (end product)
P.	Ni	i.	Carbonic anhydrase	X.	uric acid
Q.	Zn	ii.	Xanthine oxidase	Y.	methane
R.	Mo	iii.	Coenzyme F_{430}	Z.	carbonic acid

The correct match is

(a) P – iii – Y ; Q – i – Z ; R – ii – X

(b) P – iii – Y ; Q – ii – X ; R – i – Z

(c) P – ii – X ; Q – i – Y ; R – iii – Z

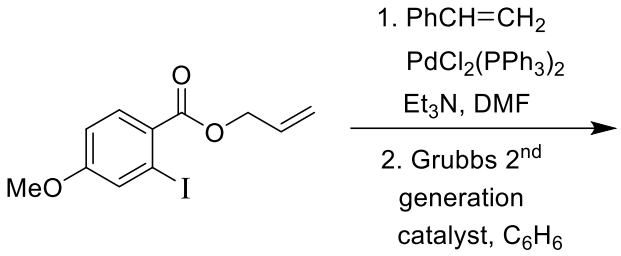
(d) P – i – X ; Q – iii – Z ; R – ii – Y

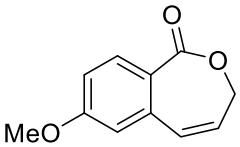
93. **Match the items in column I with those of column II**

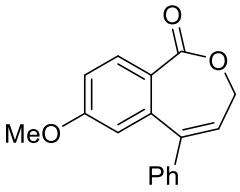
	Column I		Column II
P.	Conductometric titration	i.	Voltage
Q.	Amperometric titrations	ii.	Resistance
R.	pH metric titration	iii.	ΔI
S.	Differential pulse polarography	iv.	I_d

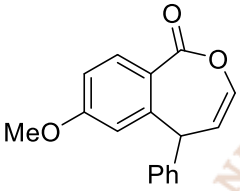
	P	Q	R	S
(a)	ii	iv	i	iii
(b)	iii	i	ii	iv
(c)	iii	ii	iv	i
(d)	i	iii	iv	ii

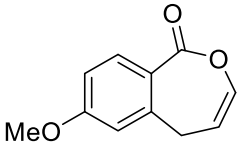
94. **The major product formed in the following reaction is**



(a) 

(b) 

(c) 

(d) 

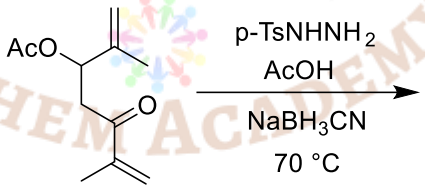
95. **X-rays of 173 pm wavelength are reflected by the (111) plane of a cubic primitive crystal at θ = 30°. The unit cell length (in pm) is closest to**

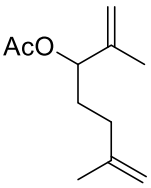
(a) 173 (b) 300 (c) 346 (d) 600

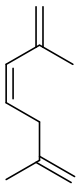
96. **The molar residual entropy (in JK^{-1}) of solid OCS would be closest to**

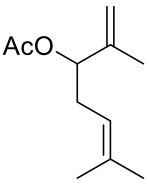
(a) 0 (b) 2.9 (c) 5.8 (d) 8.7

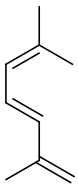
97. **The major product formed in the following reaction is**



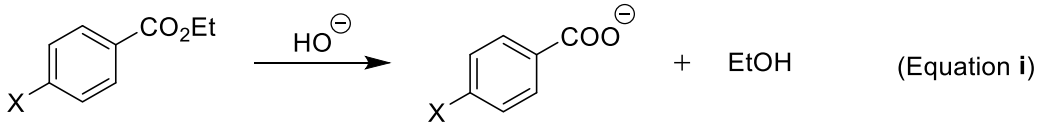
(a) 

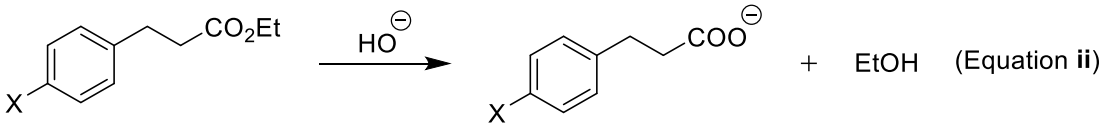
(b) 

(c) 

(d) 

98. **True statement regarding Hammett reaction constant(ρ) for the following transformations given in equations i and ii is**





(a) ρ for (i) and (ii) is same and positive

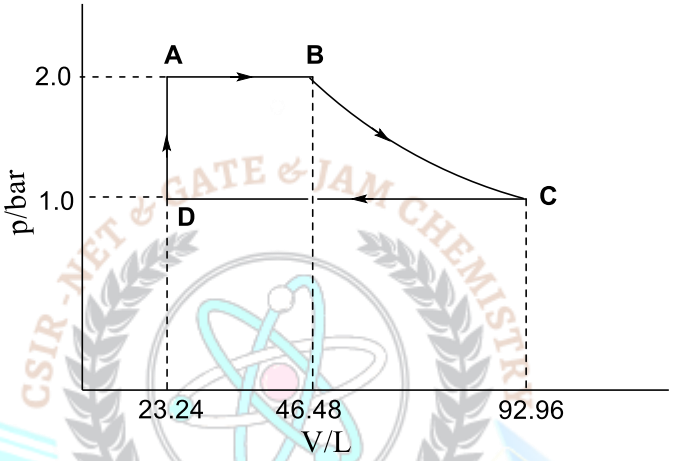
(b) ρ for (i) and (ii) is same and negative

(c) ρ for (i) is larger positive value than for (ii)

(d) ρ for (i) is negative and for (ii) is positive

99. **1.0 mol of a perfect monatomic gas is put through the cycle shown in the figure. The total work (in J) done during the cycle is**

($1\text{L-bar} = 100\text{ J}, R = 8.3\text{ J K}^{-1}\text{mol}^{-1} = 0.083\text{ L-bar K}^{-1}\text{mol}^{-1}, \ln 2 = 0.7$)



(a) 930 (b) −4183 (c) 8831 (d) −5113

100. **The Huckel molecular orbital of benzene that is degenerate with the molecular orbital $\frac{1}{2}(\chi_2 + \chi_3 - \chi_5 - \chi_6)$ is**

(a) $\frac{1}{\sqrt{12}}(2\chi_1 + \chi_2 - \chi_3 - 2\chi_4 - \chi_5 + \chi_6)$

(b) $\frac{1}{2}(\chi_2 - \chi_3 + \chi_5 - \chi_6)$

(c) $\frac{1}{\sqrt{12}}(2\chi_1 - \chi_2 - \chi_3 + 2\chi_4 - \chi_5 + \chi_6)$

(d) $\frac{1}{\sqrt{6}}(\chi_1 - \chi_2 + \chi_3 - \chi_4 + \chi_5 - \chi_6)$

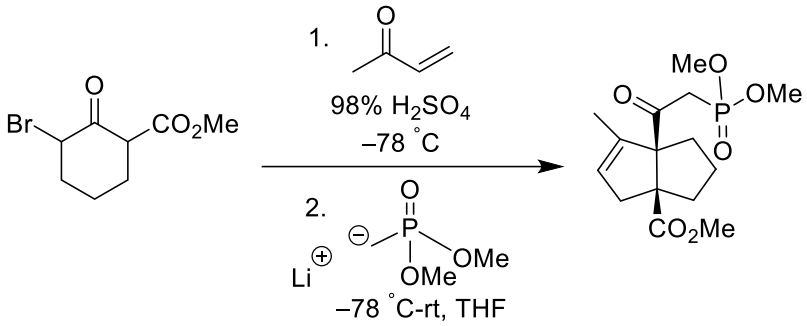
101. **For the reaction $K + Br_2 \longrightarrow KBr + Br$, which follows the harpoon mechanism, the reactive cross section is closest to (Use $\frac{e^2}{4\pi\varepsilon_0} = 2.3 \times 10^{-28}$ Jm, Ionization energy of $K = 422.5\text{ kJ mol}^{-1}$, electron affinity of $Br_2 = 250\text{ kJ mol}^{-1}$ and $N_A = 6 \times 10^{23}\text{ mol}^{-1}$)**

(a) $50 \times 10^{-18}\text{m}^2$ (b) $2 \times 10^{-18}\text{ m}^2$ (c) $64 \times 10^{-18}\text{ m}^2$ (d) $16 \times 10^{-18}\text{ m}^2$

102. **In the pure rotational microwave spectrum of a XY molecule. The adjacent lines are separated by 4 cm^{-1}. If the molecule is irradiated by a radiation of $30,000\text{ cm}^{-1}$, the first Stokes line (in cm^{-1}) appears at**

(a) 29988 (b) 30012 (c) 30004 (d) 29996

103. **The correct order of the reactions involved in the following transformation is**



(a) Michael addition, Quasi-Favorskii rearrangement, Aldol condensation

(b) Quasi-Favorskii rearrangement, Michael addition, Aldol condensation

(c) Michael addition, Aldol condensation, Quasi-Favorskii rearrangement

(d) Aldol condensation, Quasi-Favorskii rearrangement, Michael addition

104. **The correct match of spin-only magnetic moment for the complexes cis-$[Fe(phen)_2(NCS\text{-}N)_2]$ (P) and $[Fe(phen)_3]Cl_2$ (Q) at 300 K is**

(a) 4.89 BM for both P and Q (b) 0 BM for both P and Q

(c) 4.89 BM for P and 0 BM for Q (d) 0 BM for P and 4.89 BM for Q

105. **In spectrofluorimetric determination in solution**

[P] absorbance of analyte solution is kept near to 0.05

[Q] oxygen is eradicated from solution

[R] pH of solution is controlled

[S] wavelength of incident light is always above 400 nm

Correct form the above is

(a) P, Q and S (b) Q, R and S (c) P, Q and R (d) P, R and S

106. **The electrolyte solution that has the smallest Debye-length at 298 K is**

(a) 0.01 M NaCl (b) 0.01 M Na_2SO_4 (c) 0.01 M $CuCl_2$ (d) 0.01 M $LaCl_3$

107. **Consider the following statements:**

P. The highest oxidation state of Group 8 elements is more readily shown in their oxides than in fluorides

Q. Fe can exist in −2 formal oxidation state also

R. Mn, Tc and Re easily form M(II) compounds

The correct statement(s) is/are

(a) P and Q (b) P and R (c) Q and R (d) R only

108. $(C_p - C_v)$ **for a non-ideal gas differs from** $(C_p - C_v)$ **for a perfect gas by the expression**

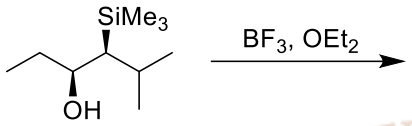
(a) $\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial U}{\partial P}\right)_S$ (b) $\left(\frac{\partial V}{\partial T}\right)_P \left(\frac{\partial U}{\partial V}\right)_T$ (c) $-\frac{1}{T}\left(\frac{\partial V}{\partial T}\right)_P \left(\frac{\partial U}{\partial V}\right)_T$ (d) $\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial U}{\partial T}\right)_P$

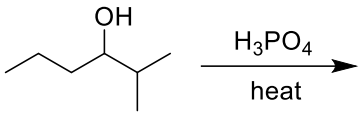
109. **In trans-1, 2-dichloroethylene, the IR inactive mode is**

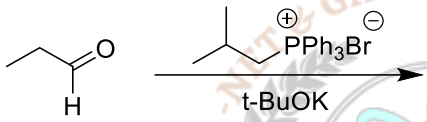
(a) C−Cl symmetric stretch (b) C−Cl asymmetric stretch

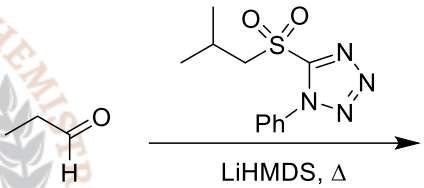
(c) C−H asymmetric stretch (d) In phase out of plane C−Cl bend

110. **The reaction that gives (E)-2-methylhex-3-ene as the major product is**

(a) 

(b) 

(c) 

(d) 

111. **The correct order of metal-carbon distance is**

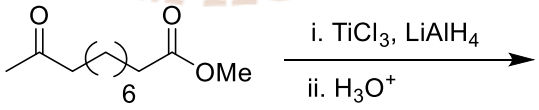
(a) $Fe(\eta^5\text{-}Cp)_2 > Co(\eta^5\text{-}Cp)_2 > Ni(\eta^5\text{-}Cp)_2$

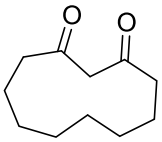
(b) $Fe(\eta^5\text{-}Cp)_2 > Ni(\eta^5\text{-}Cp)_2 > Co(\eta^5\text{-}Cp)_2$

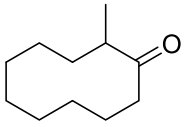
(c) $Ni(\eta^5\text{-}Cp)_2 > Fe(\eta^5\text{-}Cp)_2 > Co(\eta^5\text{-}Cp)_2$

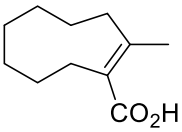
(d) $Ni(\eta^5\text{-}Cp)_2 > Co(\eta^5\text{-}Cp)_2 > Fe(\eta^5\text{-}Cp)_2$

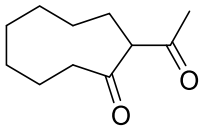
112. **The major product formed in the following reaction is**



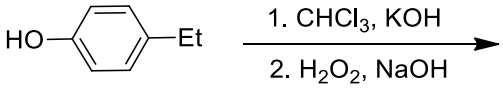
(a) 

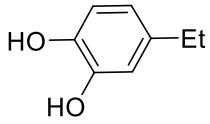
(b) 

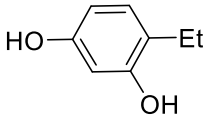
(c) 

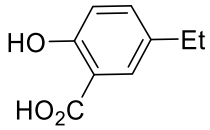
(d) 

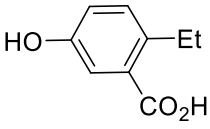
113. **The major product formed in the following reaction is**



(a) 

(b) 

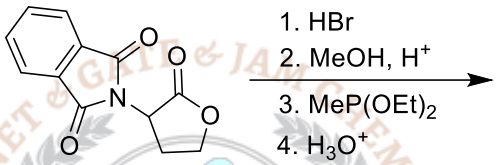
(c) 

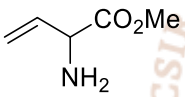
(d) 

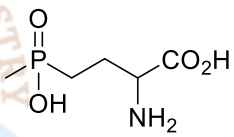
114. **The order of a surface catalysed unimolecular reaction, at very low and very high pressures of the reactant, would be, respectively**

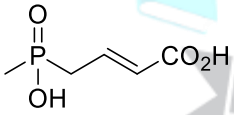
(a) 0, 0 (b) 1, 0 (c) 0, 1 (d) 1, 1

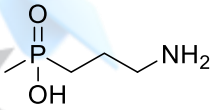
115. **The major product formed in the following reaction is**



(a) 

(b) 

(c) 

(d) 

116. **In the electronic spectrum of $[IrBr_6]^{2-}$, the number of charge transfer bands(s) and their origin are, respectively**

(a) Two, ligand → metal ($\sigma \rightarrow t_{2g}$ and $\sigma \rightarrow a_{1g}^{*}$)

(b) One, ligand → metal ($\sigma \rightarrow e_g$)

(c) Two, ligand → metal ($\sigma \rightarrow t_{2g}$ and $\sigma \rightarrow e_g$)

(d) One, ligand → metal ($\sigma \rightarrow t_{2g}$)

117. **The correct statements for dithionite and dithionate anions from the following are**

[P] both have S-S bond

[Q] both are dianionic

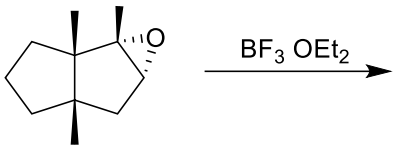
[R] oxidation state of sulphur is +3 and +5, respectively

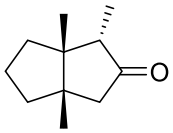
[S] sulphur in dithionate has lone pair of electrons

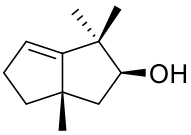
The correct statement(s) is/are

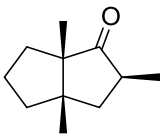
(a) P, Q and R (b) P, Q and S (c) Q, R and S (d) P and Q only

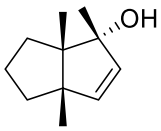
118. **The major product formed in the following reaction**



(a) 

(b) 

(c) 

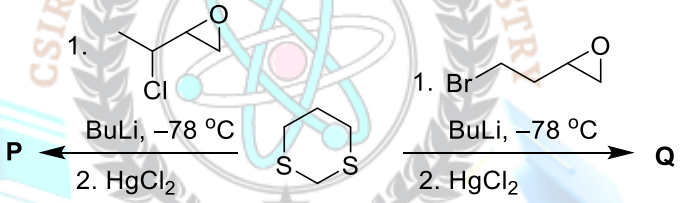
(d) 

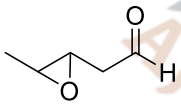
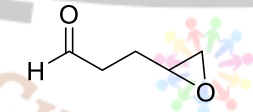
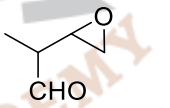
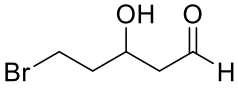
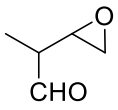
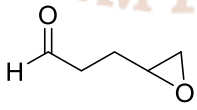
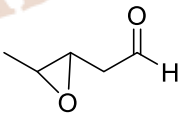
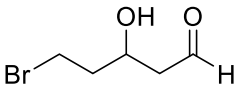
119. **In linear variation method using two orthogonal basis functions, the two roots obtained are ϵ_0 and $\epsilon_1(\epsilon_0 < \epsilon_1)$. The correct relation of these with exact ground and first excited state energies, E_0 and E_1 respectively, is**

(a) $\epsilon_0 \geq E_0$ and $\epsilon_1 < E_1$ (b) $\epsilon_0 < E_1$ and $\epsilon_1 \geq E_1$

(c) $\epsilon_0 < E_0$ and $\epsilon_1 < E_1$ (d) $\epsilon_0 \geq E_0$ and $\epsilon_1 \geq E_1$

120. **The major products P and Q formed in the following reactions are**



	P	Q	P	Q
(a)			(b) 	
(c)			(d) 	

Answer Key

PART - B

Q.No	Ans
21.	b
22.	c
23.	b

Q.No	Ans
31.	b
32.	b
33.	c

Q.No	Ans
41.	b
42.	b
43.	d

Q.No	Ans
51.	d
52.	c
53.	d

24.	c
25.	c
26.	c
27.	a
28.	a
29.	c
30.	b

34.	d
35.	c
36.	a
37.	a
38.	a
39.	b
40.	a

44.	b
45.	d
46.	b
47.	a
48.	c
49.	d
50.	d

54.	d
55.	b
56.	d
57.	b
58.	c
59.	d
60.	b

PART - C

Q.No	Ans
61.	a
62.	c
63.	a
64.	d
65.	a
66.	b
67.	a
68.	b
69.	a
70.	a
71.	d
72.	b
73.	b
74.	b
75.	c

Q.No	Ans
76.	c
77.	b
78.	b
79.	b
80.	c
81.	b
82.	c
83.	a
84.	a
85.	b
86.	a
87.	d
88.	b
89.	a
90.	b

Q.No	Ans
91.	c
92.	a
93.	a
94.	a
95.	b
96.	c
97.	c
98.	c
99.	b
100.	a
101.	b
102.	a
103.	c
104.	c
105.	c

Q.No	Ans
106.	d
107.	a
108.	b
109.	a
110.	d
111.	d
112.	b
113.	a
114.	b
115.	b
116.	c
117.	a
118.	a
119.	d
120.	a