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CSIR-UGC-NET (Chemical Science) June-2013

Q.21 – Q.70 Multiple Choice Question (MCQ), carry TWO marks each (for each wrong answer: – 0.5). You are required to Answer Maximum 35 Questions.

21. **Which of the following pairs has the highest difference in their first ionization energy?**

(a) Xe, Cs (b) Kr, Rb (c) Ar, K (d) Ne, Na

22. **The ligand in uranocene is**

(a) $C_8H_8^{2-}$ (b) $C_5H_5^{2-}$ (c) C_6H_6 (d) $C_4H_4^{2-}$

23. **In metal-olefin interaction, the extent of increase in metal → olefin π-back-donation would**

(a) Lead to a decrease in C=C bond length

(b) Change the formal oxidation state of the metal

(c) Change the hybridisation of the olefin carbon from sp^2 to sp^3

(d) Increase with the presence of electron donating substituents on the olefin

24. **The oxidation state of molybdenum in $[(\eta^7\text{-tropylium})Mo(CO)_3]^+$ is**

(a) +2 (b) +1 (c) 0 (d) −1

25. **The reaction of $[PtCl_4]^{2-}$ with two equivalents of NH_3 produces**

(a) cis-$[Pt(NH_3)_2Cl_2]$ (b) trans-$[Pt(NH_3)_2Cl_2]$

(c) Both cis-$[Pt(NH_3)_2Cl_2]$ and trans-$[Pt(NH_3)_2Cl_2]$ (d) cis-$[Pt(NH_3)_2Cl_4]^{2-}$

26. **The electronic transition responsible for the colour of the transition metal ions is**

(a) $d_\pi \rightarrow d_\sigma$ (b) $d_\pi \rightarrow d_{\sigma^*}$ (c) $d_\pi \rightarrow d_{\pi^*}$ (d) $d_\sigma \rightarrow d_{\pi^*}$

27. **The number of metal-metal bonds in $[W_2(OPh)_6]$ is**

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

28. **The Mulliken symbols for the spectroscopic states arising from the free-ion term F are**

(a) $T_{2g} + E_g$ (b) $T_{1g} + T_{2g} + T_{1u}$ (c) $T_{1g} + T_{2g} + A_{2g}$ (d) $A_{1g} + T_{2g} + T_{1g}$

29. **Which of the following is used as propellant for whipping creams?**

(a) N_2O (b) NO (c) N_2O_3 (d) N_2O_5

30. **Flame proof fabrics contain**

(a) $H_2NC(O)NH_2.Na_2SO_4$ (b) $H_2NC(S)NH_2.Na_2SO_4$

(c) $H_2NC(O)NH_2.H_3PO_4$ (d) $H_2NC(S)NH_2.H_3PO_4$

31. **Among the compounds P-S, those which hydrolyse easily are,**

P	Q	R	S
NCl_3	NF_3	$BiCl_3$	PCl_3

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

32. **The coordination geometry of copper(II) in the type-I copper protein plastocyanin is**

(a) square planar (b) tetrahedral (c) octahedral (d) distorted tetrahedral

33. **The metal ions present in the active site of nitrogenase enzyme co-factor are**

(a) Fe, Mo (b) Fe, W (c) Fe, Cu (d) Fe, Ni

34. **The reaction $[(CO)_5Mn(Me)] + CO \longrightarrow [(CO)_5Mn\{C(O)Me\}]$ is an example for**

(a) oxidative addition (b) electrophilic substitution

(c) nucleophilic substitution (d) migratory insertion

35. **The number of EPR signals observed for octahedral Ni(II) complexes is**

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

36. **For neutron activation analysis of an element, the favourable characteristics of both the target and the product are from the following**

[P] High neutron cross-section area target

[Q] Long half-life of the product

[R] Low neutron cross-section area of the target

[S] Low half-life time of the product

The correct characteristics from the above are,

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

37. **The concentrations of a species A undergoing the reaction $A \rightarrow P$ is $1.0, 0.5, 0.33, 0.25$ mol dm^{-3} at $t = 0, 1, 2$ and 3 seconds, respectively. The order of the reaction is**

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

38. **The difference in energy levels of $n = 2$ and $n = 1$ of a particle-in-a one-dimensional box is 6 units of energy. In the same units, what is the difference in energy levels of $n = 3$ and $n = 2$ for the above system?**

(a) 4 (b) 5 (c) 9 (d) 10

39. **The wave function Ψ of a certain system is the linear combination**

$$\Psi = \sqrt{\frac{1}{4}}\Psi_1 + \sqrt{\frac{3}{4}}\Psi_2$$

Where Ψ_1 and Ψ_2 are energy eigen functions with eigen values (non-degenerate) E_1

and E_2 respectively. What is the probability that the system energy will be observed to be E_1?

(a) $\sqrt{\frac{3}{16}}$ (b) $\frac{3}{4}$ (c) $\frac{1}{4}$ (d) $\sqrt{\frac{1}{4}}$

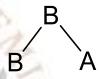
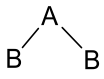
40. What is the atomic term symbol for helium atom with electronic configuration $1s^2$?

(a) $^2S_{\frac{1}{2}}$ (b) $^1P_0$ (c) $^1S_0$ (d) $^1S_1$

41. A molecule contains the following symmetry operations: $E, 2C_6, 2C_3, C_2, 3\sigma_d, 3\sigma_v$. The number of classes and order of the symmetry point group is

(a) 3, 12 (b) 5, 12 (c) 6, 12 (d) 6, 6

42. A triatomic molecule of the type AB_2 shows two IR absorption lines and one IR-Raman line. The structure of the molecule is

(a) B-B-A (b) B-A-B (c)  (d) 

43. In NMR spectroscopy, the product of the nuclear 'g' factor (g_N). the nuclear magneton (β_N) and the magnetic field strength (B_0) gives the

(a) Energy of transition from to α to β state (b) Chemical shift

(c) Spin-spin coupling constant (d) Magnetogyric ratio

44. An aqueous mixed solution of NaCl and HCI is exactly neutralized by an aqueous NaOH solution. The number of components in the final mixture is

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

45. The lowest pressure at which the liquid phase of a pure substance can exist is known as

(a) Critical point pressure (b) super-incumbent pressure

(c) triple-point pressure (d) saturation vapour pressure

46. A chemical reaction involving

nonlinear molecule + nonlinear molecule ⇌ nonlinear activated complex

The number of vibrational degrees of freedom in the activated complex, containing N atoms, is

(a) 3N − 5 (b) 3N − 6 (c) 3N − 7 (d) 3N − 8

47. Calculate the total number of microstates for 6 identical particles with their occupation numbers {1, 2, 3} in three states is

(a) 6 (b) 12 (c) 60 (d) 720

48. If the concentration(c) is increased to 4 times its original value(c), the change in

molar conductivity for strong electrolytes is (where b is Kohlrausch constant)

(a) 0 (b) $b\sqrt{c}$ (c) $2b\sqrt{c}$ (d) $4b\sqrt{c}$

49. The atom recombination reactions

	E_a		$\Delta S^{\#}$		$\Delta H^{\#}$
(a)	0	;	+ve	;	+ve
(c)	+ve	;	−ve	;	−ve

	E_a		$\Delta S^{\#}$		$\Delta H^{\#}$
(b)	0	;	−ve	;	−ve
(d)	+ve	;	+ve	;	+ve

50. In the Lindemann mechanism of unimolecular reactions, the observed order at low concentration is

(a) 0.5 (b) 1 (c) 1.5 (d) 2

51. The aggregation of surfactant molecules is known as

(a) Micelles (b) clusters (c) gel (d) colloid

52. The coordinates for the atoms in a body-centred cubic unit cell are

(a) (0,0,0) and $(1/2, 0, 0)$ (b) (0,0,0) and $(1/2, 1/2, 1/2)$

(c) (0,0,0) and $(0,1/2, 0)$ (d) (0,0,0) and $(0, 0, 1/2)$

53. The inter planar distance(Å) for a (100) plane in a cubic structure with the lattice parameter of 4Å is

(a) 1 (b) 2 (c) 4 (d) 8

54. The correlation coefficient of two parameters is found to be -0.99. It may be concluded that the two parameters are

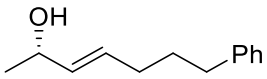
(a) Strongly correlated

(b) almost uncorrelated

(c) connected by a cause-effect relationship

(d) not connected by a cause-effect relationship

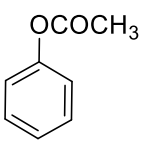
55. The IUPAC name for the compound given below is

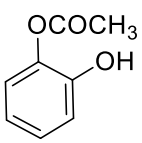


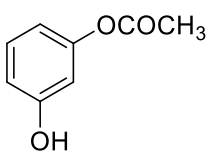
(a) (2R, 3Z)-7-phenylhept-3-en-2-ol (b) (2S, 3Z)-7-phenylhept-3-en-2-ol

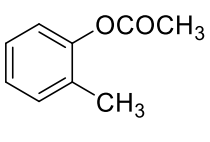
(c) (2R, 3E)-7-phenylhept-3-en-2-ol (d) (2S, 3E)-7-phenylhept-3-en-2-ol

56. Among the following esters, the one that undergoes acid hydrolysis fastest is

(a) 

(b) 

(c) 

(d) 

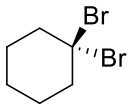
57. Reaction of cyclohexyl benzyl ether with hydrogen in the presence of 10% Pd/C

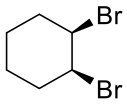
yields

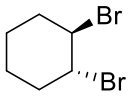
(a) Cyclohexanol and toluene (b) cyclohexanol and benzyl alcohol

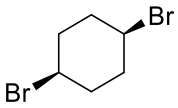
(c) cyclohexane and benzyl alcohol (d) cyclohexane and toluene

58. Among the following dibromocyclohexanes, the one that reacts fastest with sodium iodide to give cyclohexene is

(a) 

(b) 

(c) 

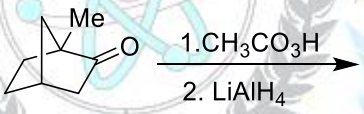
(d) 

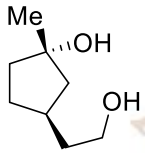
59. Match the following drugs with their medicinal activity

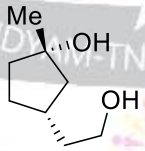
(P)	**5-fluorouracil**	**(i)**	**anti-bacterial**
(Q)	**Amoxicillin lowering**	**(ii)**	**cholesterol**
		(iii)	**Anticancer**
		(iv)	**Anti-inflammatory**

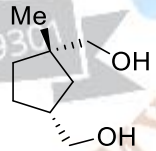
(a) P - i ; Q - ii (b) P - iv ; Q - iii (c) P - iii ; Q - iv (d) P - iii ; Q - i

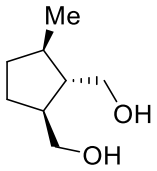
60. The major product formed in the following reaction sequence is



(a) 

(b) 

(c) 

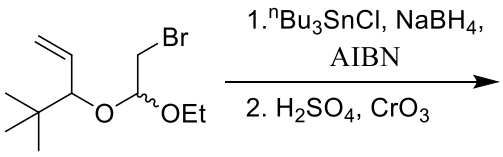
(d) 

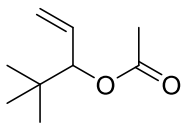
61. The biosynthetic precursor for the steroids is

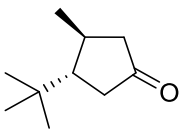
(a) Secologanin (b) shikimic acid

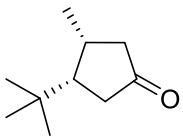
(c) mevalonic acid (d) α-ketoglutaric acid

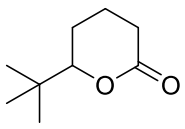
62. The major product formed in the following reaction sequence is



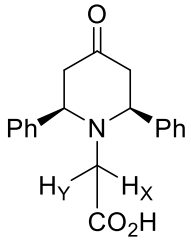
(a) 

(b) 

(c) 

(d) 

63. In the compound given below, the hydrogens marked X and Y are

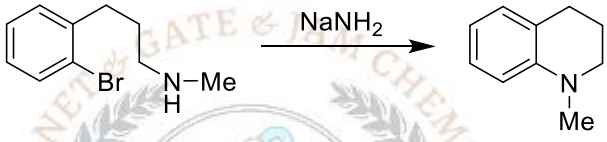


(a) Homotopic (b) isotopic (c) enantiotopic (d) diastereotopic

64. **In the IR spectrum, the absorption band due to carbonyl group in phenyl acetate appears at**

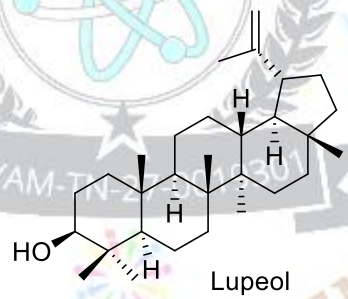
(a) 1800 cm^{-1} (b) 1760 cm^{-1} (c) 1710 cm^{-1} (d) 1660 cm^{-1}

65. **The reactive intermediate involved in the following reaction is**



(a) a carbocation (b) a carbanion (c) a free radical (d) an aryne

66. **Number of isoprene units present in lupeol is**



(a) Two (b) four (c) six (d) eight

67. **The heterocyclic ring present in the amino acid histidine is**

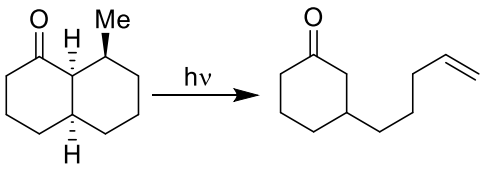
(a) Pyridine (b) tetrahydropyrrole (c) indole (d) imidazole

68. **The gauche conformation ($\theta = 60°$) of n- butane posseses**

(a) Plane of symmetry; and is achiral (b) C_2-axis of symmetry; and is chiral

(c) Centre of symmetry; and is achiral (d) Plane of symmetry; and is chiral

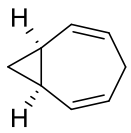
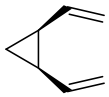
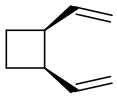
69. **The following photochemical conversion proceeds through**



(a) Barton reaction (b) Paterno-Buchi reaction

(c) Norrish type I reaction (d) Norrish type II reaction

70. **Among the following dienes, the one that undergoes a degenerate cope rearrangement is**

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

Q.71 – Q.145 Multiple Choice Question (MCQ), carry FOUR marks each (for each wrong answer: –1). You are required to Answer Maximum 25 Questions.

71. **A radio isotope ^{41}Ar initially decays at the rate of 34500 disintegrations/minute, but decay rate falls to 21500 disintegrations/minute after 75 minutes. The $t_{\frac{1}{2}}$ for ^{41}Ar is:**

(a) 90 minutes (b) 110 minutes (c) 180 minutes (d) 220 minutes

72. **The orders of reactivity of ligands, NMe_3, PMe_3 and CO with complexes $MeTiCl_3$ and $(CO)_5Mo(thf)$ are**

(a) CO > PMe_3 > NMe_3 and CO > NMe_3 > PMe_3

(b) PMe_3 > CO > NMe_3 and NMe_3 > CO > PMe_3

(c) NMe_3 > PMe_3 > CO and CO > PMe_3 > NMe_3

(d) NMe_3 > CO > PMe_3 and PMe_3 > NMe_3 > CO

73. **The number of lone-pairs are identical in the pairs:**

(a) XeF_4, ClF_3 (b) XeO_4, ICl_4^- (c) XeO_2F_2, ICl_4^- (d) XeO_4, ClF_3

74. **Among the following, those can act as massbauer nuclei are**

(P)	(Q)	(R)	(S)
^{129}I	^{57}Co	^{57}Fe	^{121}Sb

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

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

75. **Which of the pairs will generally result in tetrahedral coordination complexes, when ligands are Cl^- or OH^-:**

(P)	(Q)	(R)	(S)
Be(II), Ba(II)	Ba(II), Co(II)	Co(II), Zn(II)	Be(II), Zn(II)

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

76. **Silica gel contains $[CoCl_4]^{2-}$ as an indicator. When activated, silica gel becomes dark blue while upon absorption of moisture, its colour changes to pale pink. This is because,**

(a) Co(II) changes its coordination from tetrahedral to octahedral

(b) Co(II) changes its oxidation state to Co(III)

(c) tetrahedral crystal field splitting is NOT equal to octahedral crystal field splitting

(d) Co(II) forms kinetically labile while Co(III) forms kinetically inert complexes

77. For the metalloprotein hemerythrin, the statement that is NOT TRUE is

(a) There are two iron centers per active site

(b) both iron centers are hexacoordinated in the active site

(c) one iron is hexacoordinated while the other is pentacoordinated in the active state

(d) it is found in marine invertebrates

78. For a tetragonally distorted Cr(III) complex, zero-field splitting results in the following number of Kramer's doublets

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

79. Intense band at 15000 cm^{-1} in the UV-visible spectrum of $[Bu_4N]_2Re_2Cl_8$ is due to the transition:

(a) $\pi \rightarrow \pi^*$ (b) $\delta \rightarrow \delta^*$ (c) $\delta \rightarrow \pi^*$ (d) $\pi \rightarrow \delta^*$

80. Electron change in reduction of $Ce(SO_4)_2$, $KMnO_4$, HNO_2 and I_2 with hydrazine in acidic medium, respectively is

(a) 1e, 1e, 2e and 4e (b) 1e, 3e, 2e and 4e

(c) 2e, 3e, 1e and 4e (d) 2e, 4e, 1e and 3e

81. The compound that will behave as an acid in H_2SO_4 is

(a) CH_3COOH (b) HNO_3 (c) $HClO_4$ (d) H_2O

82. Among the oxides of nitrogen, N_2O_3, N_2O_4 and N_2O_5, the compound(s) having N−N bond is/are

(a) N_2O_4 and N_2O_5 (b) N_2O_3 and N_2O_5 (c) N_2O_3 and N_2O_4 (d) N_2O_5 only

83. The treatment of PhBr with n-BuLi yields

(a) 2n-BuPh + Br_2 + Li_2 (b) PhPh + Octane + 2LiBr

(c) n-BuPh + LiBr (d) PhLi + n-BuBr

84. Though cyclobutadiene(C_4H_4) is highly unstable and readily polymerizes in its free state, its transition metal complexes could be isolated because

(a) It engages in long-range interaction with transition metals

(b) It gains stability due to formation of $(C_4H_4)^{2-}$ on binding to transition metals

(c) Its polymerization ability reduces in presence of transition metal

(d) It becomes stable in presence of transition metals due to formation of $(C_4H_4)^{2+}$

85. **Identify the order representing increasing π- acidity of the following ligands C_2F_4, NEt_3, CO and C_2H_4**

(a) $CO < C_2F_4 < C_2H_4 < NEt_3$

(b) $C_2F_4 < C_2H_4 < NEt_3 < CO$

(c) $C_2H_4 < NEt_3 < CO < C_2F_4$

(d) $NEt_3 < C_2H_4 < C_2F_4 < CO$

86. **The species with highest magnetic moment (spin only value) is**

(a) VCl_6^{4-} (b) $(\eta^5\text{-}C_5H_5)_2Cr$ (c) $[Co(NO_2)_6]^{3-}$ (d) $[Ni(EDTA)]^{2-}$

87. **The number of metal-metal bonds in $Ir_4(CO)_{12}$ is**

(a) 4 (b) 6 (c) 10 (d) 12

88. **Three bands in the electronic spectrum of $[Cr(NH_3)_6]^{3+}$ are due to the following transitions:**

(P)	(Q)	(R)
$^4A_{2g} \rightarrow {}^4T_{1g}$	$^4A_{2g} \rightarrow {}^4T_{2g}$	$^4A_{2g} \rightarrow {}^2E_g$

Identify the correct statement about them

(a) Intensity of (P) is lowest (b) Intensity of (R) is lowest

(c) Intensity of (P), (Q) and (R) are similar (d) Intensity of (Q) and (R) are similar

89. **Identify the pairs in which the covalent radii of elements are almost similar**

(P)	(Q)	(R)	(S)
Nb, Ta	Mo, W	La, Lu	Sc, Y

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

90. **Consider the given lanthanide(III) ions :**

(P)	(Q)	(R)
Nd(III)	Gd(III)	Dy(III)

The magnetic moment closest to the spin only value is(are) for

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

91. **The Δ_t of the given complexes follows the order**

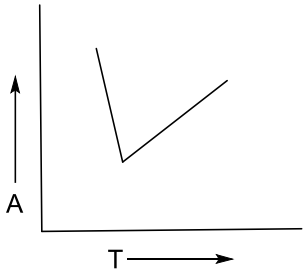
(P)	(Q)	(R)
$[CoCl_4]^{2-}$	$[CoBr_4]^{2-}$	$[Co(NCS)_4]^{2-}$

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

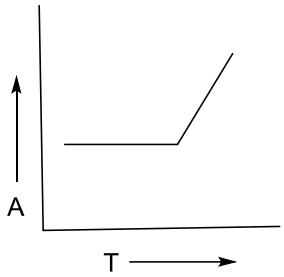
92. **In complexometric titration, S(substrate) + T(titrant) ⟶ P(product)**

The end point is estimated spectrophotometrically. If S and P have ε = 0 , the shape of the titration curve would look like

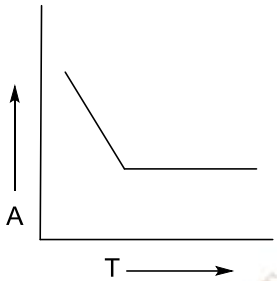
(a)



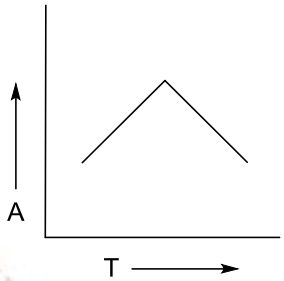
(b)



(c)



(d)



93. Identify the chiral complexes from the following:

(P)	**(Q)**	**(R)**
$[Cr(EDTA)]^-$	$[Ru(bipy)_3]^{3+}$	$[PtCl(diene)]^+$

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

94. Distribution ratio of "A" between $CHCl_3$ and water is 9.0. It is extracted with several, 5 mL aliquots of $CHCl_3$. The number of aliquots needed to extract 99.9 % of "A" from its 5 mL aqueous solution are.

(a) 2 (b) 3 (c) 4 (d) 5

95. The correct equilibrium order for the interconversion of different forms of SiO_2 is

(a) tridymite ⇆ quartz ⇆ cristobalite ⇆ liquid SiO_2

(b) quartz ⇆ tridymite ⇆ cristobalite ⇆ liquid SiO_2

(c) quartz ⇆ cristobalite ⇆ tridymite ⇆ liquid SiO_2

(d) cristobalite ⇆ tridymite ⇆ quartz ⇆ liquid SiO_2

96. The rate equation for the reaction, $2AB + B_2 \longrightarrow 2AB_2$, is given by $rate = k[AB][B_2]$. A possible mechanism consistent with this rate law is.

(a) $2AB + B_2 \xrightarrow{slow} 2AB_2$

(b) $AB + AB \rightleftharpoons A_2B_2(fast)$

$A_2B_2 + B_2 \rightarrow 2AB_2$

(c) $AB + B_2 \xrightarrow{slow} AB_3$

$AB_3 + AB \xrightarrow{slow} 2AB_2$

(d) $AB + B_2 \rightleftharpoons AB_3(fast)$

$AB_3 + AB \xrightarrow{slow} 2AB_2$

97. Observe the following statements:

(P) In the H_2O_2 reaction, explosion occurs when the rate of chain branching exceeds that of chain termination

(Q) The order of the reaction, $nA \longrightarrow$ products is 2.5 for this reaction $t_{½} \propto [A]_0^{-3/2}$

(R) Unimolecular gas phase reaction are second order at low pressure but become first order at high pressure

which of the following is correct?

(a) P, Q and R are correct (b) only Q is correct

(c) only R is correct (d) P and Q are correct

98. **For the particle in a box problem in (0, L) an approximate wave function is given as $x(L/2 - x)\,(L - x)$. The average energy $\bar{E}$ for such a state will obey,**

(a) $h^2/8mL^2 < \bar{E} < h^2/2mL^2$ (b) $\bar{E} > h^2/2mL^2$

(c) $h^2/4mL^2 < \bar{E} < h^2/2mL^2$ (d) $0 < \bar{E} < h^2/8mL^2$

99. **For two variables x and y, the following data set is given:**

x	y
−1	1
0	2
1	3

The correct statement for the covariance-P and correlation coefficient-Q of x and y is,

(a) $P = 2/3 \;;\; Q = 1$ (b) $P = -2/3 \;;\; Q = 1$

(c) $P = -2/3 \;;\; Q = -1$ (d) $P = 0 \;;\; Q = 0$

100. **The hydrogenic orbital with the form of the radial function**

$$r^2(\alpha_1 - r)(\alpha_2 - r)\exp(-\beta r),$$

Where α_1, α_2 and β are constants, may be identified as a,

(a) 3d orbital (b) 4f orbital (c) 5d orbital (d) 5f orbital

101. **The operator $[x, [x, p^2]]$ is identical with,**

(a) $[px, [x, p]]$ (b) $[xp, [x, p]]$ (c) $-[p, [x^2, p]]$ (d) $[x, [x^2, p]]$

102. **For the particle-in-a-box problem in $(0, L)$, the value of $\langle x^3 \rangle$ in the $n \to \infty$ limit would be,**

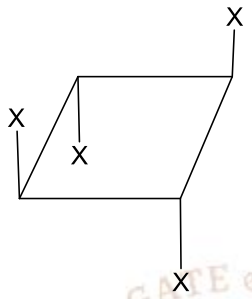
(a) $L^3/6$ (b) $L^3/3$ (c) $L^3/4$ (d) $L^4/4$

103. **Identity the Mulliken notation for the following irreducible representation**

E	C_n	nC_2	i	σ_h
1	1	−1	−1	−1

(a) A'_{1u} (b) A''_{2u} (c) B'_{2u} (d) A'_{2u}

104. Identify the point group symmetry of the following molecule (all C−C bond lengths are equal)



(a) C_2v
(b) S_4
(c) D_2d
(d) D_4d

105. The ground state term symbol for Nb (atomic number-41) is ^6D. The electronic configuration corresponding to this term symbol is,

(a) $[Kr]4d^3 5s^2$ (b) $[Kr]4d^4 5s^1$ (c) $[Kr]4d^5 5s^0$ (d) $[Kr]4d^3 5s^1 5p^1$

106. In the presence of an external magnetic field (normal Zeeman Effect), the transition ^1D in to,

(a) 9 lines (b) 8 lines (c) 7 lines (d) 6 lines

107. Identify the Huckel determinant for cyclobutadiene

(a) $\begin{vmatrix} \alpha-E & \beta & 0 & 0 \\ \beta & \alpha-E & \beta & 0 \\ 0 & \beta & \alpha-E & \beta \\ 0 & 0 & \beta & \alpha-E \end{vmatrix}$ (b) $\begin{vmatrix} \alpha-E & \beta & 0 & \beta \\ \beta & \alpha-E & \beta & 0 \\ 0 & \beta & \alpha-E & \beta \\ \beta & \beta & 0 & \alpha-E \end{vmatrix}$

(c) $\begin{vmatrix} \alpha-E & \beta & 0 & \beta \\ \beta & \alpha-E & \beta & 0 \\ 0 & \beta & \alpha-E & \beta \\ \beta & 0 & \beta & \alpha-E \end{vmatrix}$ (d) $\begin{vmatrix} \alpha-E & \beta & 0 & \beta \\ \beta & \alpha-E & \beta & 0 \\ 0 & \beta & \alpha-E & \beta \\ 0 & 0 & \beta & \alpha-E \end{vmatrix}$

108. On mixing 120 ml of 0.05 M CH_3COOH and 40 ml of 0.05 M of NaOH, the pH of the solutions is $(pK_a = -\log K_a)$

(a) $pK_a + 0.69$ (b) $pK_a + 0.301$ (c) pK_a (d) $pK_a - 0.69$

109. A system consists of gaseous H_2, O_2, H_2O and CO_2 where the amount of CO_2 is specified and the equilibrium constant for the reaction, $2H_{2(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(g)}$ is known. The number of degrees of freedom of the system is,

(a) 2 (b) 3 (c) 4 (d) 5

110. "Colloids are thermodynamically unstable with reference to bulk but kinetically stable". Identify the correct pair.

	Statement		Reasons
(I)	Thermodynamically unstable	(P)	Interfacial surface tension
(II)	Kinetically stable	(Q)	Electrical double layer

(a) (I) ↔ (Q) ; (II) ↔ (P) (b) (I) ↔ (P) ; (II) ↔ (Q)

(c) (I) ↔ (P) ; (II) ↔ (P) (d) (I) ↔ (Q) ; (II) ↔ (Q)

111. **An AX system gave 4 lines at 4.72, 4.6, 1.12 and 1.0 ppm away from TMS using an NMR spectrometer operating at 100 MHz. What are the values of J_{AX} (in Hz) and δ_{AX} (in ppm), respectively?**

(a) 12 and 3.6 (b) 6 and 3.6 (c) 12 and 2.86 (d) 6 and 2.86

112. **The equilibrium population ratio (n_j/n_i) of a doubly-degenerate energy level (E_j) lying at energy 2 units higher than a lower non-degenerate energy level (E_i), assuming $k_BT = 1$unit, will be**

(a) $2e^{-2}$ (b) $2e^{2}$ (c) e^{2} (d) e^{-2}

113. **Which of the following statements is true for a cyclic process?**

(a) $\oint dq = 0$

(b) $\oint dw = 0$

(c) Heat can be completely converted into work

(d) Work can be completely converted into heat

114. **Identify, from the following, the correct ionic strengths for (I) a 0.01 molal solution of NaCl and (II) a 0.01 molal solution of Na_2SO_4**

(a) (I) 0.010 mol kg^{-1} ; (II) 0.010 mol kg^{-1}

(b) (I) 0.010 mol kg^{-1} ; (II) 0.030 mol kg^{-1}

(c) (I) 0.010mol kg^{-1} ; (II) 0.025 mol kg^{-1}

(d) (I) 0.010mol kg^{-1} ; (II) 0.015 mol kg^{-1}

115. **A system has 100 degenerate energy levels and 100 bosons are kept in it. Find the entropy of the system at equilibrium**

(a) $10^{-2}\ k_B$ (b) $10^{2}\ k_B$ (c) $460.6\ k_B$ (d) $4.606\ k_B$

116. **Which is correct Nernst equation for redox reaction $O + ne \rightleftharpoons R$?**

(a) $E = E^0 - \frac{RT}{nF}\ln\frac{[O]}{[R]}$ (b) $\frac{[O]}{[R]} = e^{\frac{nF}{RT}(E-E^0)}$

(c) $\frac{[O]}{[R]} = e^{-\frac{nF}{RT}(E-E^0)}$ (d) $\frac{[O]}{[R]} = e^{\frac{RT}{nF}(E-E^0)}$

117. **A plane of spacing "d" shows first order Bragg diffraction at angle θ. A plane of spacing 2d,**

(a) shows Bragg diffraction at 2θ (b) shows Bragg diffraction at $\theta/2$

(c) shows Bragg diffraction at $\sin^{-1}\left(\frac{\sin\theta}{2}\right)$ (d) shows Bragg diffraction at $\sin^{-1}\left(\frac{\sin 2\theta}{2}\right)$

118. **In the formation of H_2 molecule from 2H atoms placed at positions A and B, and separated by a distance r_{AB}, a part of the spatial wavefunction is.**

$$\phi_A(1)\,\phi_A(2) + \phi_B(1)\phi_B(2)$$

(a) This is a covalent term and is important as $r_{AB} \leftrightarrow \infty$

(b) This is an ionic term and is important as $r_{AB} \leftrightarrow \infty$

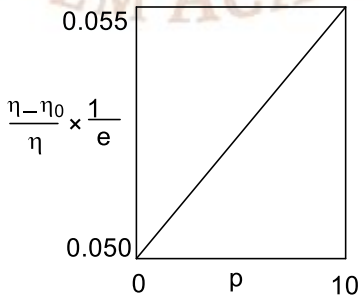
(c) This is a covalent term and is important is $r_{AB} \leftrightarrow 0$

(d) This is an ionic term and is important as $r_{AB} \leftrightarrow 0$

119. **A 0.1 M solution of compound "X" shows 50 % transmittance when a cell of 1 *cm* width is used at λ_1 nm. Another 0.1 M solution of compound "Y" gives the optical density value of 0.1761 using 1 cm cell at λ_1 nm. What will be the transmittance of a solution that is simultaneously 0.1 M in X and 0.1 M in Y using the same cell and at the same wavelength? (log20 = 1.301; log30 = 1.4771; log50 = 1.699)**

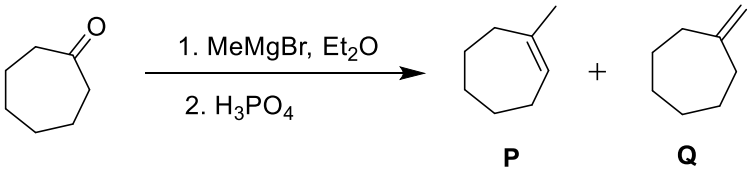
(a) 33.3% (b) 50% (c) 66.7 (d) 70%

120. **Using standard equation for intrinsic viscosity $[\eta = K\,\overline{M_V^a}$, for a solution of polymer and any information from the graph identify viscosity-average molar mass ($\overline{M_V}$) [given that $a = 0.5, K = 5 \times 10^{-5}$ L g^{-1}]**



(a) 10^3 g/mol (b) 10^4 g/mol (c) 10^5 g/mol (d) 10^6 g/mol

121. **Among the following the correct statement for the following reaction is.**



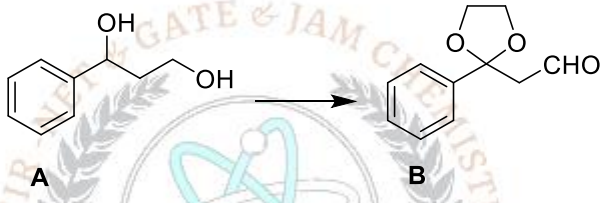
(a) P is the major product and it will have five signals in the proton decoupled ^{13}C-NMR spectrum

(b) P is the minor product and it will eight signals in the proton decoupled ^{13}C NMR spectrum

(c) Q is the major product and it will have five signals in the proton decoupled ^{13}C NMR spectrum

(d) Q is the minor product and it will have five signals in the proton decoupled ^{13}C NMR spectrum

122. For the following three step conversion of A to B, the appropriate sequence of reaction is



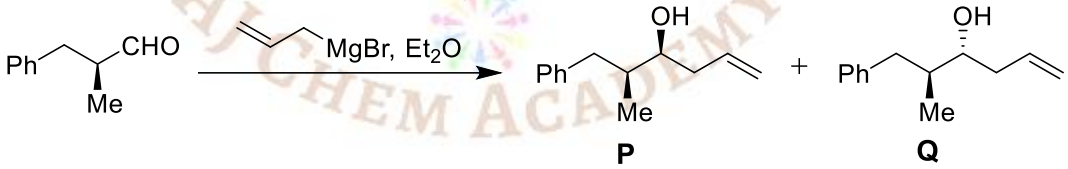
(a) MnO_2, $(CH_2OH)_2$ / p-TSA, PCC

(b) PCC, MnO_2, $(CH_2OH)_2$/ p-TSA

(c) PCC, $(CH_2OH)_2$/ p-TSA, Jones' reagent

(d) Jones' reagent, $(CH_2OH)_2$/ p-TSA, MnO_2

123. Which one of the following statements is true for the following transformation.



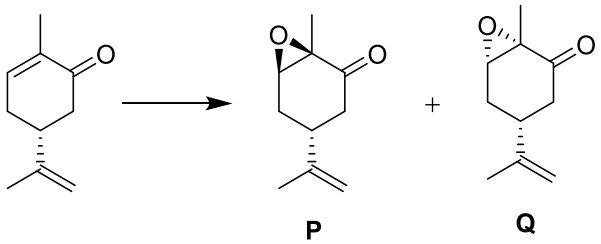
(a) P is the major product and it is a Cram-Product

(b) P is the major product and it is anti-Cram product

(c) Q is the major product and it is a Cram product

(d) Q is the major product and it is anti-Cram product

124. Which one of the following statements is true for the following transformation?



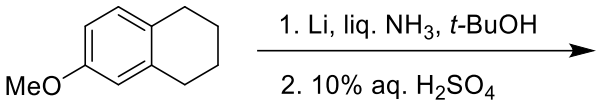
(a) suitable reagent is m-CPBA and Q is the major product

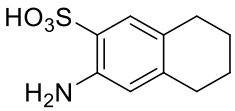
(b) suitable reagent is m-CPBA and P is the major product

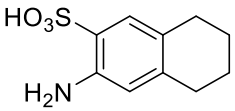
(c) suitable reagent is aq. H_2O_2/NaOH and Q is the major product

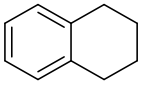
(d) suitable reagent is aq. H_2O_2/NaOH and P is the major product

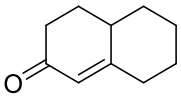
125. The compound formed in the following reaction sequence is



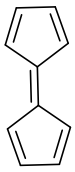
(a) 

(b) 

(c) 

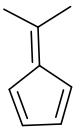
(d) 

126. Among the following compounds, the one which has highest dipole moment is,

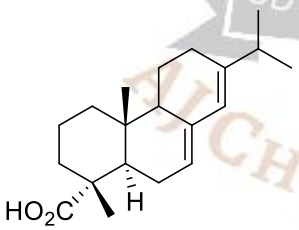
(a) 

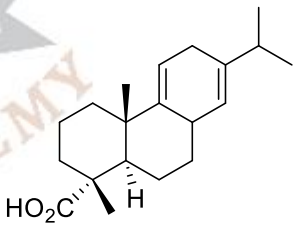
(b) 

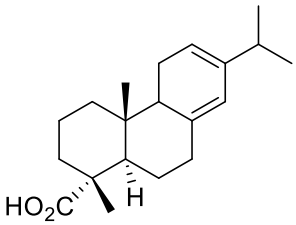
(c) 

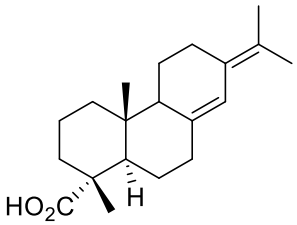
(d) 

127. In the UV-Vis spectrum, a diterpenoid exhibited a λ_{max} at 275 nm. The compound, among the choices given below, is.

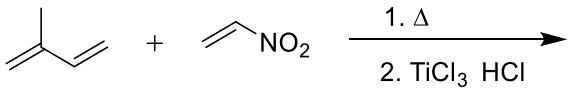
(a) 

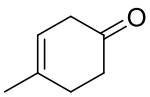
(b) 

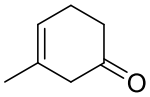
(c) 

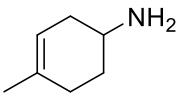
(d) 

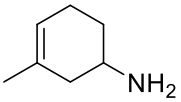
128. The major product formed in the following reaction is



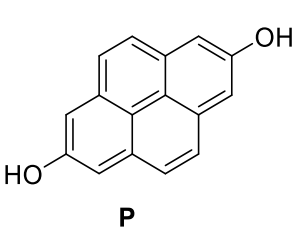
(a) 

(b) 

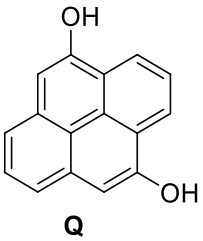
(c) 

(d) 

129. In the broad band decoupled ^{13}C-NMR spectrum, the number of signals appearing for the two pyrene diols P and Q, respectively, are.



P



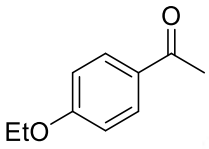
Q

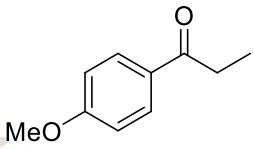
(a) eight and eight (b) eight and sixteen (c) five and ten (d) five and eight

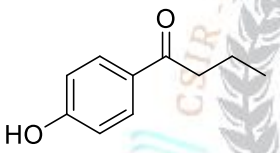
130. An organic compound exhibited the following spectral data

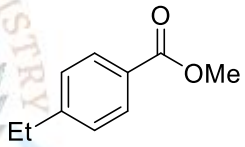
^{1}H-NMR : $7.80\ (2H, d, J = 8Hz)$, $6.80\ (2H, d, J = 8Hz)$, $4.10\ (2H, q, J = 7.2Hz)$, $2.4\ (3H, s)$, $1.25\ (3H, t, J = 7.2Hz)$

The compound among the choices given below is

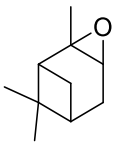
(a) 

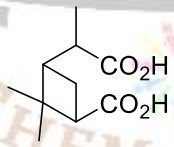
(b) 

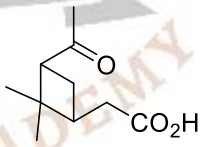
(c) 

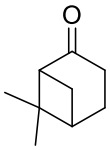
(d) 

131. α-Pinene on reaction with dilute alkaline $KMnO_4$ produces a diol, which on further oxidation with chromium trioxide gives product P, which undergoes a positive haloform test. The compound P is.

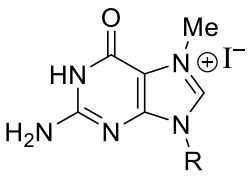
(a) 

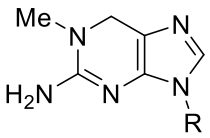
(b) 

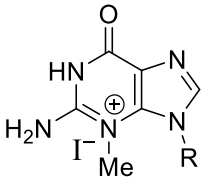
(c) 

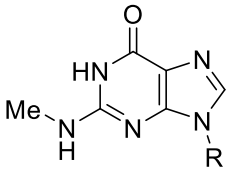
(d) 

132. The major product formed in the reaction of guanosine with one equivalent of methyl iodide is

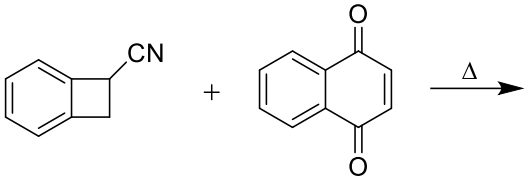
(a) 

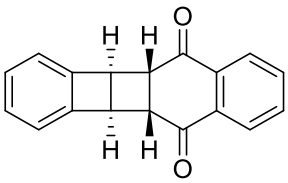
(b) 

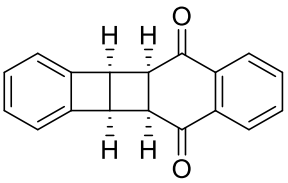
(c) 

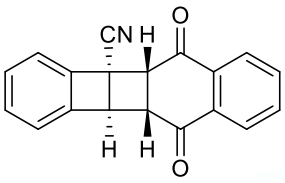
(d) 

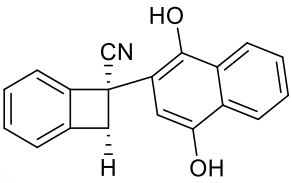
133. The major product formed in the following reaction is



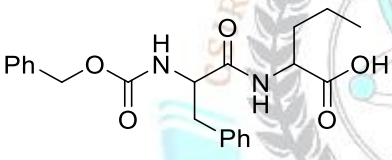
(a) 

(b) 

(c) 

(d) 

134. Reaction of the dipeptide, given below, with hydrogen in presence of 10 % palladium over carbon, produces a mixture of



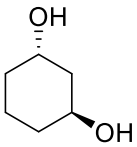
(a) Gly-Leu + toluene + carbon dioxide

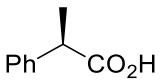
(b) Phe-Leu + toluene + carbon dioxide

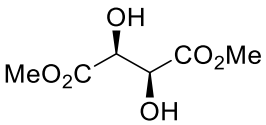
(c) Phe-Leu + benzyl alcohol + carbon dioxide

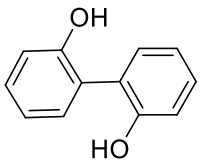
(d) Gly-Leu + benzyl alcohol + carbon dioxide

135. Among the following, the most suitable reagent for carrying out resolution of racemic 3-methylcyclohexanone is,

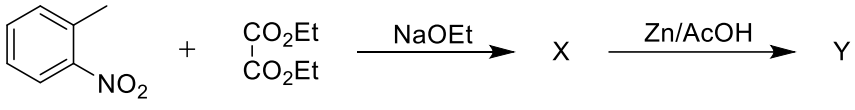
(a) 

(b) 

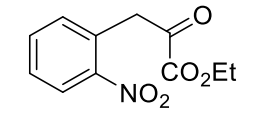
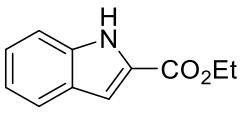
(c) 

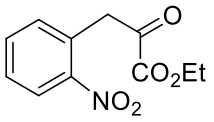
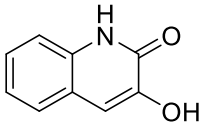
(d) 

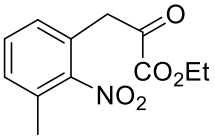
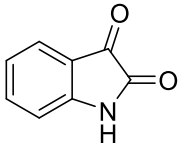
136. In the following reaction sequence, structures of the major products X and Y are.

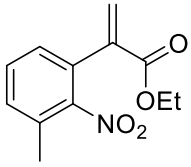
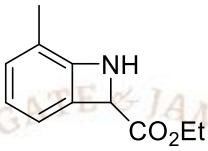


X **Y**

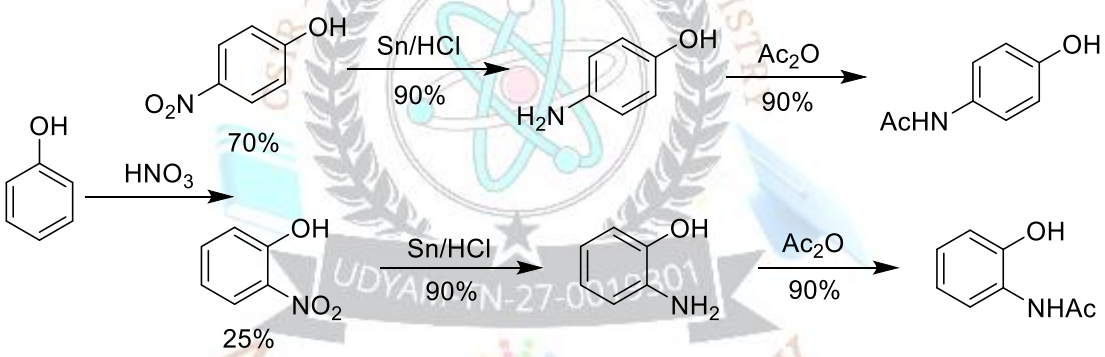
(a)  ; 

(b)  ; 

(c)  ; 

(d)  ; 

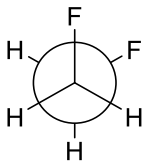
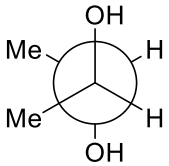
137. Consider the following reaction sequence

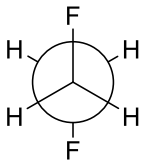
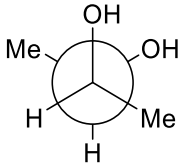


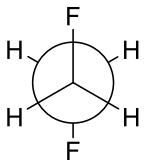
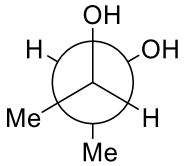
The overall yield for the formation of p-hydroyacetanilide and o-hydroxyacetanilides from phenol, respectively, are approximately.

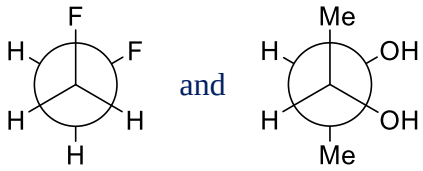
(a) 57% and 20% (b) 57% and 68% (c) 83% and 68% (d) 83% and 20%

138. The most stable conformations of 1,2-difluoroethane and dl-2,3-butanediol are

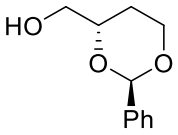
(a)  and 

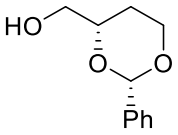
(b)  and 

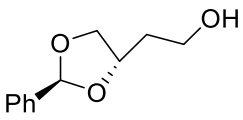
(c)  and 

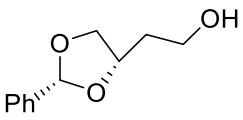
(d)  and

139. Reaction of (S)-1, 2, 4-butanetriol with benzaldehyde in the presence of a catalytic amount of p-TSA furnished the major product P. The structure of P is

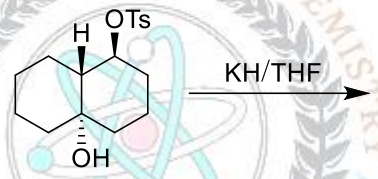
(a) 

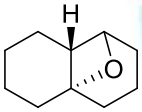
(b) 

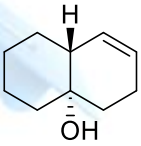
(c) 

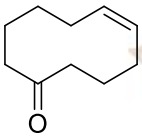
(d) 

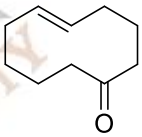
140. The major product formed in the following reaction is



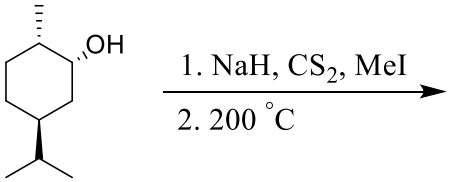
(a) 

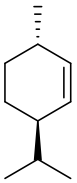
(b) 

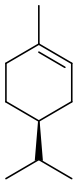
(c) 

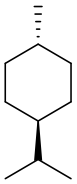
(d) 

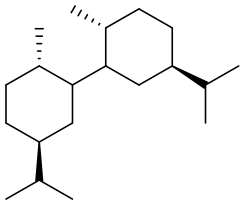
141. The major product formed in the following reaction is.



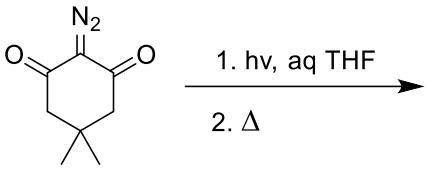
(a) 

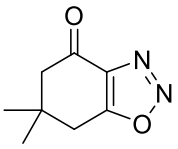
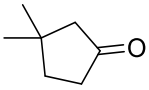
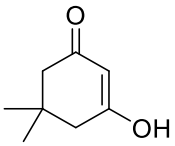
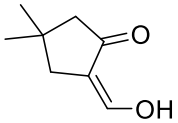
(b) 

(c) 

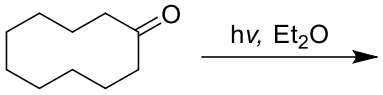
(d) 

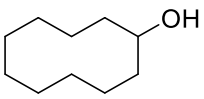
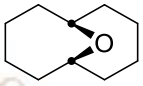
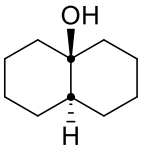
142. The major product formed in the following reaction is.



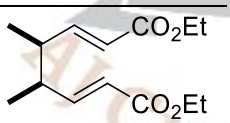
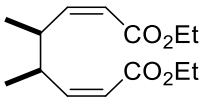
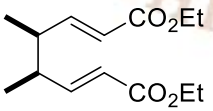
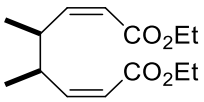
(a)  (b)  (c)  (d) 

143. The major product formed in the following reaction is

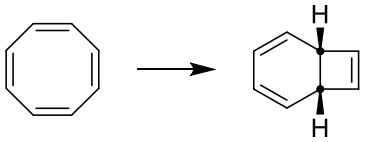


(a)  (b)  (c)  (d) 

144. Predict the condition-P and the structure of the major product-Q in the following sequence,

	P	Q		P	Q
(a)	hν ;		(b)	hν ;	
(c)	Δ ;		(d)	Δ ;	

145. The most appropriate mode of cyclisation in the following transformation is,



(a) con-rotatory in photochemical and disrotatory in thermal conditions

(b) con-rotatory in thermal; and dis-rotatory in photochemical conditions

(c) con-rotatory in thermal; and con-rotatory in photochemical conditions

(d) dis-rotatory in photochemical; and dis-rotatory in thermal conditions

Answer Key

PART - B

Q.No	Ans
21.	d
22.	a
23.	c
24.	c
25.	a
26.	b
27.	c
28.	c
29.	a
30.	c
31.	b
32.	d
33.	a
34.	d
35.	a

Q.No	Ans
36.	a
37.	a
38.	d
39.	c
40.	c
41.	c
42.	b
43.	a
44.	b
45.	c
46.	c
47.	c
48.	b
49.	b
50.	d

Q.No	Ans
51.	a
52.	b
53.	c
54.	a
55.	d
56.	b
57.	a
58.	c
59.	d
60.	b

Q.No	Ans
61.	c
62.	b
63.	c
64.	b
65.	d
66.	c
67.	d
68.	b
69.	d
70.	a

PART - C

Q.No	Ans
71.	b
72.	c
73.	a
74.	d
75.	c
76.	a
77.	b
78.	b
79.	b

Q.No	Ans
91.	a
92.	c
93.	b
94.	c
95.	b
96.	c
97.	a
98.	b
99.	a

Q.No	Ans
111.	a
112.	a
113.	d
114.	b
115.	b
116.	b
117.	c
118.	d
119.	a

Q.No	Ans
131.	c
132.	a
133.	c
134.	b
135.	c
136.	a
137.	a
138.	d
139.	b

80.	a
81.	c
82.	c
83.	d
84.	b
85.	d
86.	a
87.	b
88.	b
89.	a
90.	a

100.	c
101.	c
102.	c
103.	b
104.	c
105.	b
106.	a
107.	c
108.	**
109.	b
110	b

120.	d
121.	d
122.	a
123.	a
124.	d
125.	d
126.	b
127.	c
128.	a
129.	c
130.	a

140.	d
141.	a
142.	b
143.	d
144.	a
145	d