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CSIR-UGC-NET (Chemical Science) June - 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. **The role of H_3PO_4 in the estimation of Fe(II) with $K_2Cr_2O_7$ using diphenylamine sulphonate as indicator is to**

(a) avoid aerial oxidation of Fe(II)

(b) reduce the electrode potential of $Fe^{3+} \rightarrow Fe^{2+}$

(c) stabilize the indicator

(d) stabilize $K_2Cr_2O_7$

22. **O_2^- is**

(a) having a shorter O–O bond length than that in O_2

(b) a stronger oxidizing agent than O_2

(c) IR active

(d) unble to abstract proton from weak acids

23. **In neutron activation analysis the radiation commonly detected is**

(a) α-rays (b) β-rays (c) γ-rays (d) X-rays

24. **The metal transferred by bacteria and fungi using siderophores/siderochromes is**

(a) Mo (b) Cu (c) Fe (d) Zn

25. **Self-exchange electron transfer is fastest in**

(a) $[Ru(NH_3)_6]^{2+/3+}$ (b) $[Co(NH_3)_6]^{2+/3+}$ (c) $[Cr(H_2O)_6]^{2+/3+}$ (d) $[Fe(H_2O)_6]^{2+/3+}$

26. **The number of Ni–Ni bonds in $[CpNi(\mu\text{-}PPh_2)]_2$ complex obeying the 18 electron rule is**

(a) 0 (b) 1 (c) 2 (d) 3

27. **For the reaction of trans-$[IrX(CO)(PPh_3)_2]$ (X = F, Cl, Br, I) with O_2 correct order of variation of rate with X is**

(a) Br > I > F > Cl (b) F > Cl > Br > I

(c) F ≈ Cl ≈ Br ≈ I (d) I > Br > Cl > F

28. **The species that results by replacing one quarter of Si(IV) in pyrophyllite $[Al_2(OH)_2Si_4O_{10}]$ with Al(III) is [charge balance by K(I)]**

(a) muscovite (b) phlogopite (c) montmorillonite (d) talc

29. **The reaction of IO_3^- with I^- in aqueous acidic medium results in**

(a) I_2 and H_2O (b) I_2 and H_2O_2 (c) IO^- and H_2O (d) IO^- and H_2O_2

30. **The organic species isolobal to $[Fe(CO)_2(PPh_3)]^-$ is**

(a) CH_2^+ (b) CH^- (c) CH_3 (d) CH

31. **The oxidation state of sulphur in the dithionous and dithionic acids, respectively, are**

(a) +4, +6 (b) +4, +5 (c) +3, +5 (d) +3, +6

32. **Consider the following reaction: $Hg^{2+}_{(aq)} + X^-_{(aq)} \longrightarrow [HgX]^+_{(aq)}$. The stability constants for $[HgX]^+_{(aq)}$ for X = F, Cl and Br follow the order**

(a) F < Cl < Br (b) Br < Cl < F

(c) Cl < Br < F (d) Br < F < Cl

33. **The coordination number of Gd in $GdCl_3.6H_2O$ is**

(a) 3 (b) 6 (c) 8 (d) 9

34. **Among the following, the correct statement about π-molecular orbitals of benzene is**

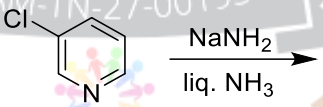
(a) Only the lowest energy MO is doubly degenerate

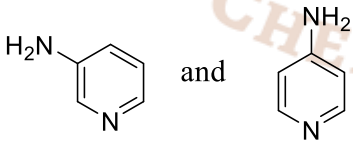
(b) Only LUMO is doubly degenerate

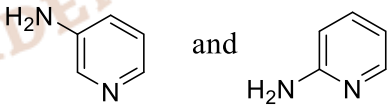
(c) Only HOMO is doubly degenerate

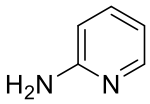
(d) Both the HOMO and LUMO are doubly degenerate

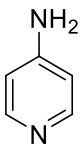
35. **The major product(s) formed in the following reaction is (are)**



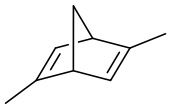
(a) 

(b) 

(c) only 

(d) only 

36. **The number of ^{1}H-NMR signals observed for the following compound is**



(a) 3 (b) 4 (c) 5 (d) 6

37. **The correct order of reactivity of the following dienes towards reaction with maleic anhydride is**

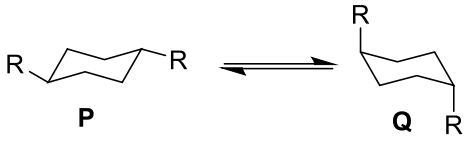
(a) E-1-chlorobuta-1,3-diene < E-penta-1,3-diene < E-1-methoxybuta-1,3-diene

(b) E-penta-1,3-diene < E-1-chlorobuta-1,3-diene < E-1-methoxybuta-1,3-diene

(c) E-1-methoxybuta-1,3-diene < E-1-chlorobuta-1,3-diene < E-penta-1,3-diene

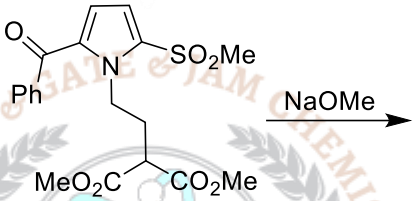
(d) E-1-methoxybuta-1,3-diene < E-penta-1,3-diene < E-1-chlorobuta-1,3-diene

38. In the following equilibrium, conformer Q is more stable than P when R is



(a) Me (b) F (c) Cl (d) OMe

39. The major product formed in the following reaction is



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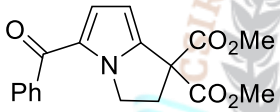

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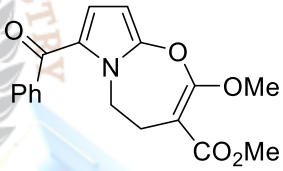

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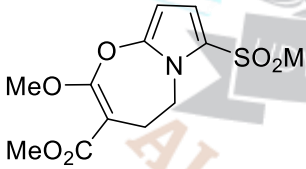

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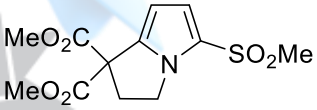
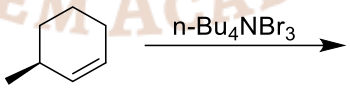
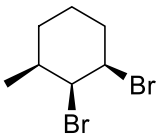


40. The major product formed in the following reaction is



(a)



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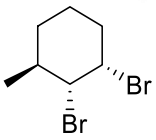

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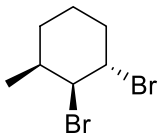

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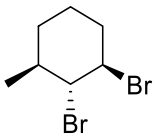
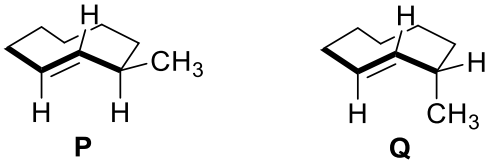
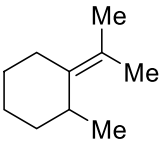


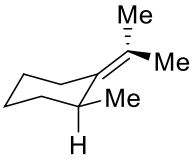
41. The relationship between P and Q is

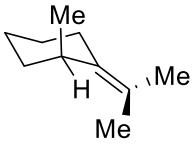


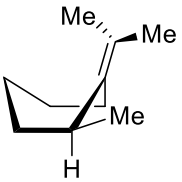
(a) Homomers (Identical) (b) Enantiomers (c) Diastereomers (d) Conformers

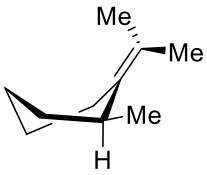
42. The most stable conformation of the following molecule is



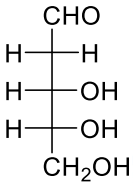
(a) 

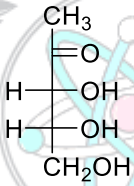
(b) 

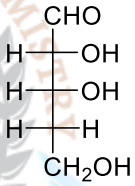
(c) 

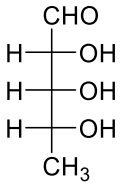
(d) 

43. Reaction of deoxymonosaccharide-P with 2 equivalents HIO_4 of affords propanediol, Formic acid and formaldehyde. The structure of P is

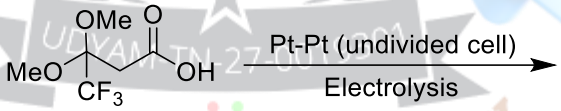
(a) 

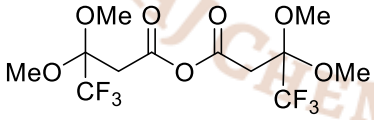
(b) 

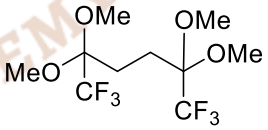
(c) 

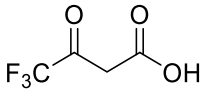
(d) 

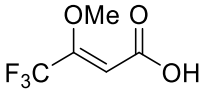
44. The major product formed in the following reaction is



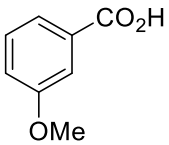
(a) 

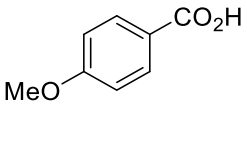
(b) 

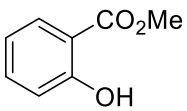
(c) 

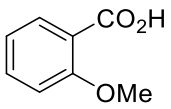
(d) 

45. The compound that will show a base peak at m/z 120 in its EI mass spectrum is

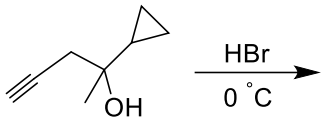
(a) 

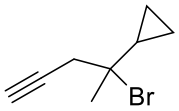
(b) 

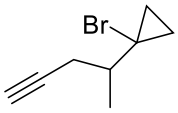
(c) 

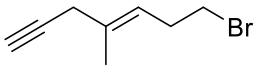
(d) 

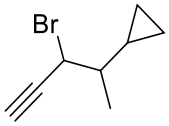
46. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

47. **The mobility of a divalent cation in water is $8 \times 10^{-8}\ m^2\ V^{-1}\ s^{-1}$. The effective radius of the ion is** **(viscosity of water $= 1$ cP; $e = 1.6 \times 10^{-19}$ C)**

(a) 106 pm (b) 212 pm (c) 424 pm (d) 318 pm

48. **The electrical double layer model among the following that consists of both fixed and diffuse layers is**

(a) Helmholtz (b) Gouy (c) Stern (d) Debye-Huckel

49. **The lowest energy unnormalized wave function of H_2^+ molecule is**

(r_1 and r_2 are the distances between the electron and nuclei 1 and 2, respectively)

(a) $\psi = \left(e^{-r_1/a_o} + e^{-r_2/a_o}\right)$ (b) $\psi = \left(e^{-r_1/a_o} - e^{-r_2/a_o}\right)$

(c) $\psi = \left(e^{-r_1/a_o}\right)$ (d) $\psi = \left(e^{-r_2/a_o}\right)$

50. **Nearest neighbour distance in a crystal system of side length a is $\frac{a}{\sqrt{2}}$ in**

(a) Face-centered cube (b) Body-centered cube

(c) Trigonal primitive (d) Primitive cube

51. **For a particle of mass m in a one-dimensional box of length 2L, the energy of the level corresponding to $n = 8$ is**

(a) $\frac{h^2}{8mL^2}$ (b) $\frac{h^2}{32mL^2}$ (c) $\frac{4h^2}{mL^2}$ (d) $\frac{2h^2}{mL^2}$

52. **The correct statement about HCl and DCl, among the following is,**

(a) DCl has a smaller zero-point energy than HCl

(b) HCl has a smaller vibration frequency than DCl

(c) The force constant k of the HCl bond is half that of DCl

(d) The reduced mass of DCl is smaller than that of HCl

53. **One mole of a mono-atomic ideal gas is transformed from 300 K and 2 atm to 600 K and 4 atm. The entropy change for this process is**

(a) $\frac{3}{2}R\ln 2$ (b) $\frac{1}{2}R\ln 2$ (c) $\frac{7}{2}R\ln 2$ (d) $\frac{5}{2}R\ln 2$

54. The allowed transition in an atomic system is

(a) $^3F_4 \rightarrow {}^3D_3$ (b) $^3F_4 \rightarrow {}^1D_3$ (c) $^3F_4 \rightarrow {}^3P_4$ (d) $^3F_4 \rightarrow {}^3D_2$

55. The total number of symmetry elements in diborane molecule is

(a) 2 (b) 4 (c) 6 (d) 8

56. A physical observable, 'x' appears with the probability distribution $e^{(-|2x-12|)}$. The average of 'x' would be

(a) 0 (b) 3 (c) 6 (d) 12

57. The rotational partition function is expected to be the smallest for the molecule, among the following,

(a) H_2 (b) Li_2 (c) N_2 (d) F_2

58. If the half-life of a reaction is inversely proportional to the square of the concentration of the reactant, the order of the reaction is

(a) 0 (b) 1 (c) 2 (d) 3

59. The degree of polymerisation ($\langle N \rangle$) and the fraction of monomer consumed (P) for a polymerisation reaction are related as

(a) $\langle N \rangle = \frac{1}{1-P}$ (b) $\langle N \rangle = \frac{1}{1+P}$ (c) $\langle N \rangle = \frac{1}{P}$ (d) $\langle N \rangle = \frac{1}{P^2}$

60. The correct match for the compounds in Column-I with the property in Column-II is

	Column I		Column II
P.	Dichlorodifluoromethane	i.	Anti-inflammatory
Q.	Sulfadiazine	ii.	Insecticidal
R.	Cortisone	iii.	Antibacterial
S.	Hexachlorobenzene	iv.	Ozone layer depletion

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

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

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

61. The correct statements about $[Ru_6C(CO)_{17}]$ cluster from the following are

[P] it is an 86-electron cluster

[Q] it is a closo structure type

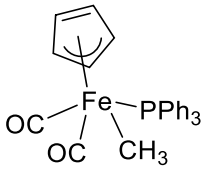
[R] its shape is capped square pyramid

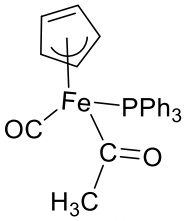
[S] carbon interacts with all the Ru centers in the cluster

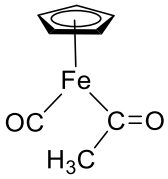
(a) P, Q, R and S (b) P and Q (c) P, Q and R (d) P, Q and S

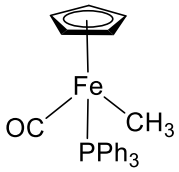
62. A plausible structure of the intermediate involved in the following reaction is

$[Fe(\eta^5\text{-}C_5H_5)(CH_3)(CO)_2] + PPh_3 \longrightarrow [Fe(\eta^5\text{-}C_5H_5)(C(=O)CH_3)(CO)(PPh_3)]$

(a) 

(b) 

(c) 

(d) 

63. In the synthesis of polydimethylsiloxane, the chain forming, branching and terminating agents respectively, are

(a) Me_2SiCl_2, Me_3SiCl and $MeSiCl_3$ (b) $Me_2SiCl_2, MeSiCl_3$ and Me_3SiCl

(c) $MeSiCl_3, Me_2SiCl_2$ and Me_3SiCl (d) $Me_2SiCl_2, MeSiCl_3$ and Me_4Si

64. The set among the following in which all numbers are magic numbers of nucleons is

(a) 20, 28, 50 and 126 (b) 24, 28, 82 and 126

(c) 20, 50, 80 and 184 (d) 28, 50, 82 and 180

65. Incorrect statement for amperometric titration is

(a) it is based on measurement of diffusion current

(b) its sensitivity is always higher than those of spectrophotometric titrations

(c) it does not generally require an indicator

(d) it requires inert atmosphere (N_2/Ar)

66. Consider the following statements with respect to Cytochrome P-450

[P] It has histidine coordinated to iron centre

[Q] It is a membrane bound metalloenzyme

[R] It has Fe(III)ion in the resting state of the enzyme

The correct statement(s) is/are

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

67. Consider the following transformation reactions in the context of co-enzyme B_{12}

[P] 1, 2-Carbon shift

[Q] Hydration of CO_2

[R] Benzene to phenol

[S] Dimethyl sulfide to dimethyl sulfoxide

The correct statement(s) for co-enzyme B_{12} is/are

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

68. The correct statements regarding Boran among the following are

[P] Nuclear spin of ^{11}B is greater than that of ^{10}B

[Q] The polarities of B−H bond and C−H bonds are opposite

[R] Cross-section of neutron absorption for ^{10}B is much more than that of ^{11}B

[S] Boran reacts with boiling aq. NaOH solution to form $NaB(OH)_4$

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

69. Choose the correct statement/s among the following

[P] LiF is more soluble than $LiClO_4$ in water

[Q] The standard reduction potential $[E^o]$ of Li is more negative than that of Na

[R] The heat of hydration of $Li^+_{(g)}$ is greater than that of $Na^+_{(g)}$

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

70. Choose the correct statement(s) among the following

[P] The dihedral angle in O_2F_2 is 0°

[Q] OF_2 is generally prepared by reacting fluorine gas with dilute (2%) aq. NaOH solution

[R] O_2F_2 can be readily reduced by H_2S

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

71. The correct set of information is

(a) $[Mn(H_2O)_6]^{2+}$: $\mu_{observed} = \mu_{spin}$; $[Co(H_2O)_6]^{3+}$: Paramagnetic

(b) $[Mn(H_2O)_6]^{2+}$: $\mu_{observed} > \mu_{spin}$; $[Co(H_2O)_6]^{3+}$: Diamagnetic

(c) $[Mn(H_2O)_6]^{2+}$: $\mu_{observed} = \mu_{spin}$; $[Co(H_2O)_6]^{3+}$: Diamagnetic

(d) $[Mn(H_2O)_6]^{2+}$: $\mu_{observed} > \mu_{spin}$; $[Co(H_2O)_6]^{3+}$: Paramagnetic

72. Consider the following statements regarding electronic spectra of high spin complexes

[P] Ti^{3+} complexes exhibit one sharp band

[Q] $Co^{2+}$and Cr^{3+}complexes exhibit two broad bands

[R] Mn^{2+} complexes exhibit a series of very weak and sharp bands

[S] Ni^{2+}complexes exhibit three broad bands

The correct statement(s) are

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

73. Match the appropriate geometry on the right with each of the species on the left:

[P]	$FXeO(OSO_2F)$	(i)	linear
[Q]	$FXeN(SO_2F)_2$	(ii)	pyramidal
[R]	XeO_3	(iii)	T-shaped
[S]	$XeOF_2$	(iv)	Bent

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

74. Hydrolysis of trans-$[CoLCl(en)_2]^+$;$(L = NO_2^-, NCS^-, OH^-, Cl^-)$ results in a product (X). The tendency to form cis-isomer of the product (X) follows the order

(a) $L = NO_2^- < NCS^- < OH^- < Cl^-$

(b) $L = NO_2^- < Cl^- < NCS^- < OH^-$

(c) $L = OH^- < Cl^- < NO_2^- < NCS^-$

(d) $L = OH^- < NCS^- < Cl^- < NO_2^-$

75. Among the following reactions, those that are feasible in liquid NH_3 are

[P] $KNO_3 + AgCl \longrightarrow KCl + AgNO_3$

[Q] $NH_4Br + KNH_2 \longrightarrow KBr + 2\,NH_3$

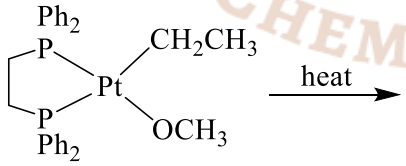
[R] $Fe(CO)_5 + 2e^- \longrightarrow [Fe(CO)_4]^{2-} + CO$

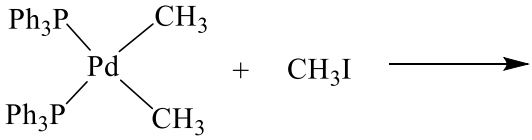
(a) (i), (ii) and (iii) (b) (i) and (ii) (c) (i) and (iii) (d) (ii) and (iii)

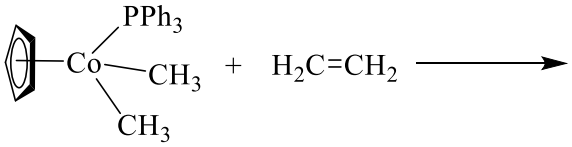
76. The cations formed upon dissolving SnF_4 and AuF_3 in liquid BrF_3 separately, respectively are

(a) SnF_3^+ and BrF_2^+ (b) BrF_2^+ and AuF_2^+ (c) BrF_2^+ only (d) SnF_3^+ and AuF_2^+

77. Consider the following reactions

(P) 

(Q) 

(R) 

The reaction(s) which will NOT produce ethane as a product is/are

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

78. Donor mode of NO ligand depends on metal. Now consider the following complexes

(in gaseous state)

[P] $[IrCl(CO)(PPh_3)_2(NO)]^+$

[Q] $[RuCl(PPh_3)_2(NO)_2]^+$

[R] $[Co(NCS)(diars)_2(NO)]^+$ **where diars** $= o\text{-}(Me_2As)_2C_6H_4$

[S] $[Cr(CN)_5(NO)]^{3-}$

The complex(es) that do NOT exhibit bent NO coordination mode is/are

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

79. **An aqueous solution of metal ion (X) gives a blood-red coloured product (Y) upon reaction with KSCN. Upon dropwise addition of NaF, the complex turns to a colourless compound (Z). Identify X, Y and Z,**

(a) aq. Fe(II), $[Fe(SCN)(H_2O)_5]^+$ and $[Fe(H_2O)_6]^{2+}$

(b) aq. Fe(III), $[Fe(SCN)(H_2O)_5]^{2+}$ and $[FeF_6]^{3+}$

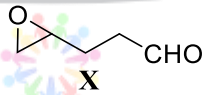
(c) aq. Fe(II), $[Fe(SCN)(H_2O)_5]^+$ and FeF_3

(d) aq. Fe(III), $[Fe(SCN)_3(H_2O)_3]^+$ and FeF_3

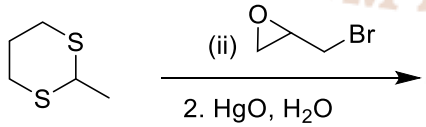
80. **Considering σ-bonding only, in the MO diagram of a metal complex with trigonal bipyramidal (TBP) geometry, the d orbitals which remain non-bonding are**

(a) d_{z^2} and d_{xz} (b) d_{xz} and d_{yz} (c) $d_{x^2-y^2}$ and d_{xy} (d) d_{z^2} and d_{yz}

81. **The correct sequence of reactions for the preparation of X is**



(a)



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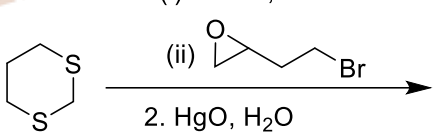

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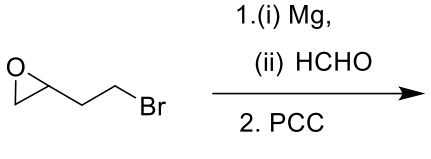
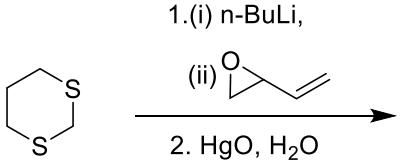
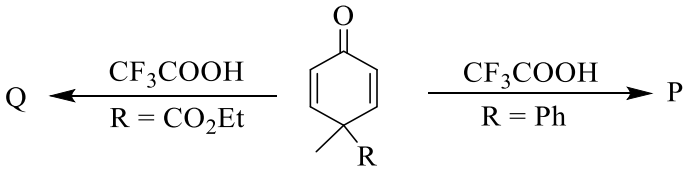


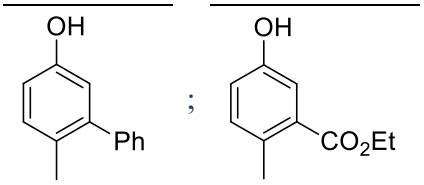
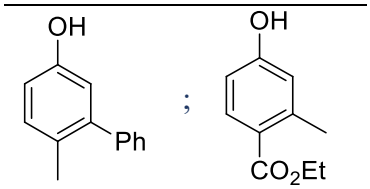
(d)

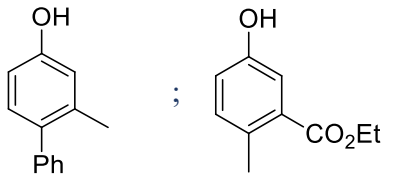
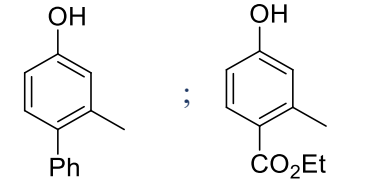


82. **Structure of P and Q in the following reactions are**

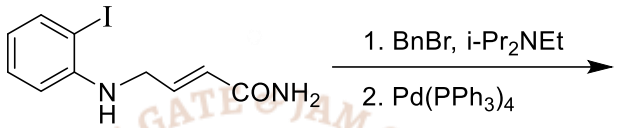


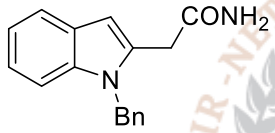
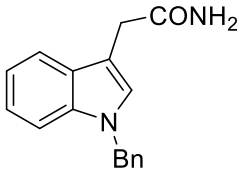
P **Q** **P** **Q**

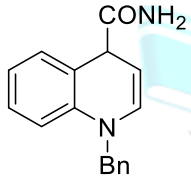
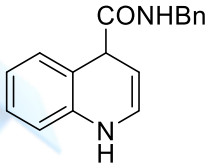
(a)  ; (b) 

(c)  ; (d) 

83. The major product of the following reaction is



(a)  (b) 

(c)  (d) 

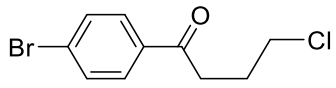
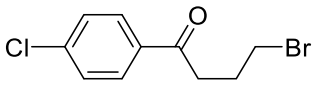
84. The compound that exhibits following spectral data is

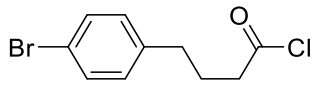
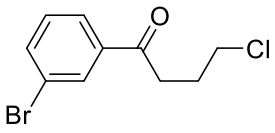
IR (ν) : 1685 cm^{-1}

^{1}H-NMR (δ) : 7.84 (d, J = 8Hz, 2H), 7.60 (d, J = 8 Hz, 2H), 3.65 (t, J = 7 Hz, 2H), 3.18 (t, J = 7 Hz, 2H), 2.25 (pentet, J = 7 Hz, 2H) ppm

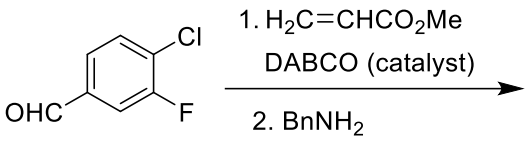
^{13}C-NMR (δ) : 28, 36, 45, 128, 130, 133, 137, 197 ppm

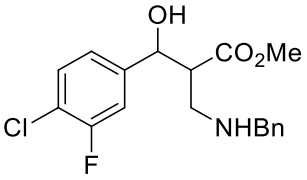
EI MS (m/z) : 200, 198 (1:1), 185, 183 (1:1)

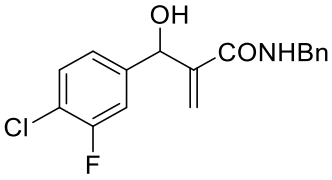
(a)  (b) 

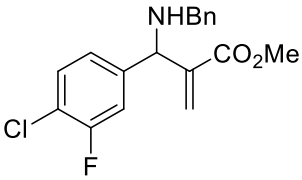
(c)  (d) 

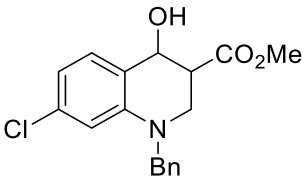
85. The major product of the following reaction sequence is



(a) 

(b) 

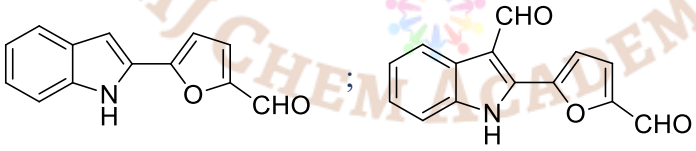
(c) 

(d) 

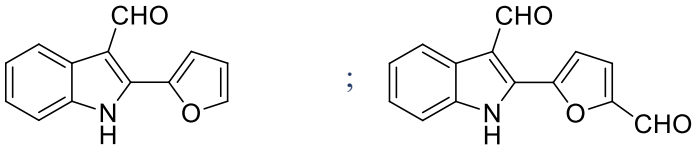
86. The major products P and Q of the following reaction sequence are

P Q

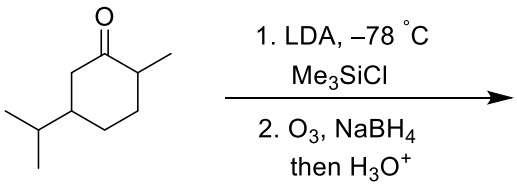
(a) 

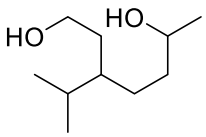
(b) 

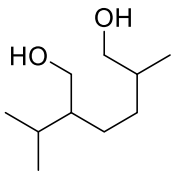
(c) 

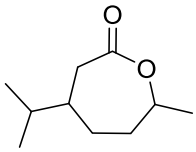
(d) 

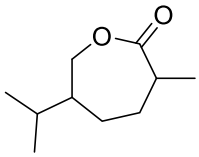
87. The major product of the following reaction is



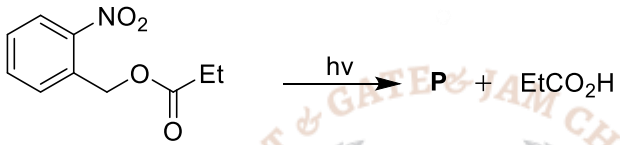
(a) 

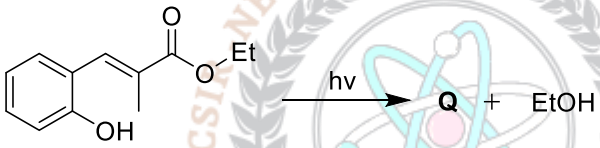
(b) 

(c) 

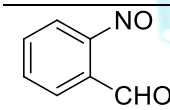
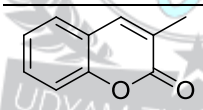
(d) 

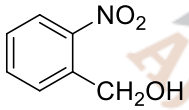
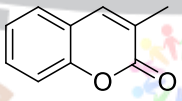
88. Structures of the products P and Q in the following photo-deprotection reactions are

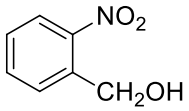
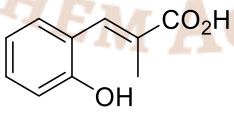


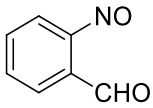
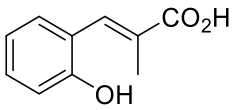


P Q

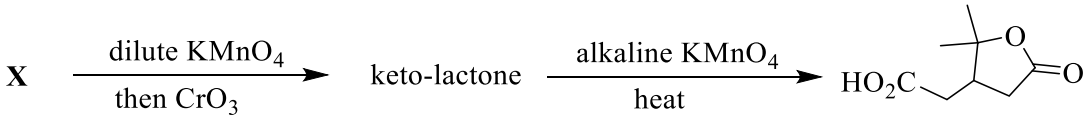
(a)  ; 

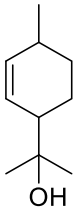
(b)  ; 

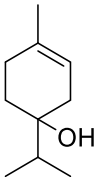
(c)  ; 

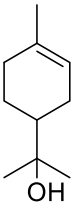
(d)  ; 

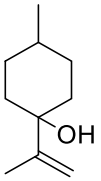
89. Structure of the monoterpene-X that undergoes following degradation is



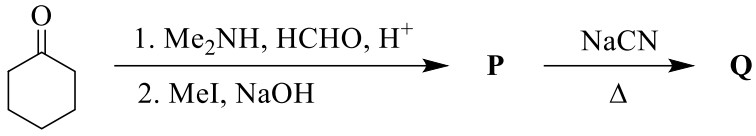
(a) 

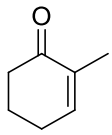
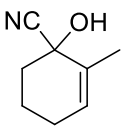
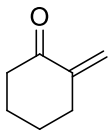
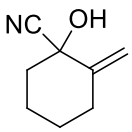
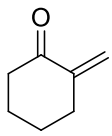
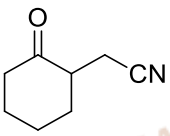
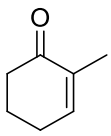
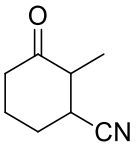
(b) 

(c) 

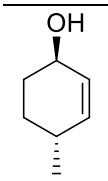
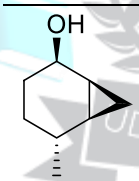
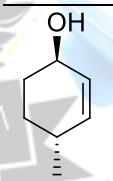
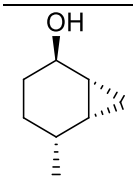
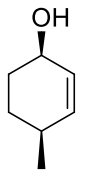
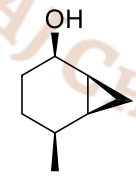
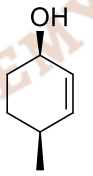
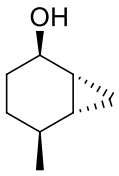
(d) 

90. The major products P and Q formed in the following reaction sequence are

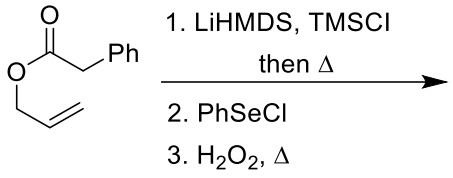


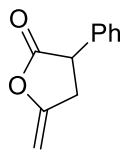
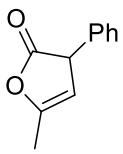
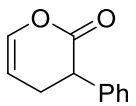
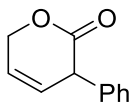
	P	Q
(a)		
(b)		
(c)		
(d)		

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

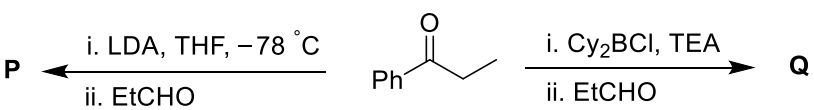
	P	Q
(a)		
(b)		
(c)		
(d)		

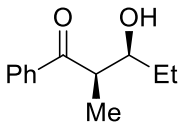
92. The major products formed in the following reaction is

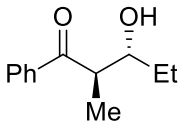


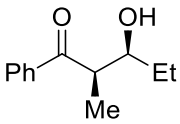
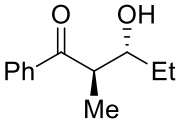
(a) 
(b) 
(c) 
(d) 

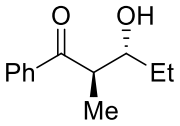
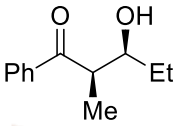
93. The major products P and Q in the following reactions are



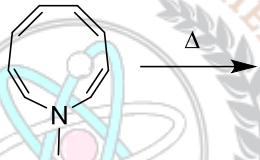
(a) P = Q = 

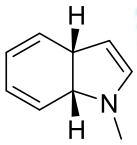
(b) P = Q = 

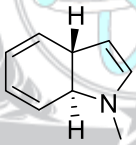
(c) P =  ; Q = 

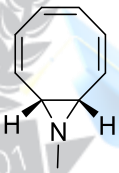
(d) P =  ; Q = 

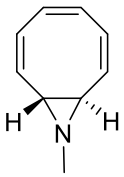
94. The major product formed in the following reaction is



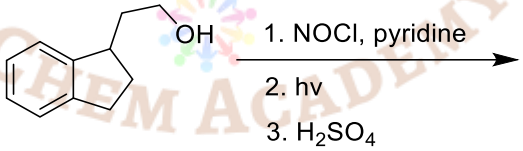
(a) 

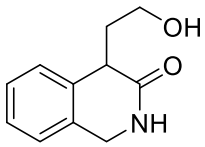
(b) 

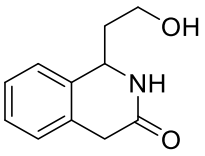
(c) 

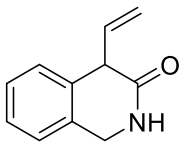
(d) 

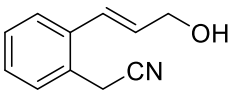
95. The major product formed in the following reaction is



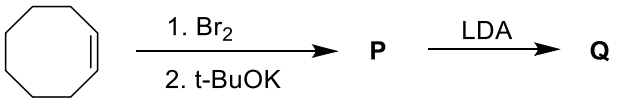
(a) 

(b) 

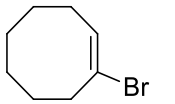
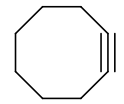
(c) 

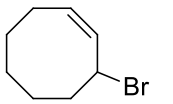
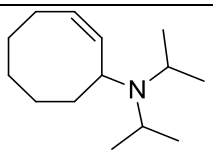
(d) 

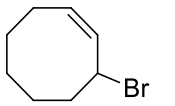
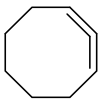
96. The major products P and Q formed in the following reaction sequence are

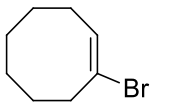
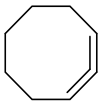


P	Q	P	Q

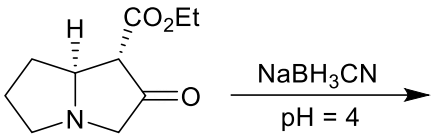
(a)  ; 
cyclooctyne

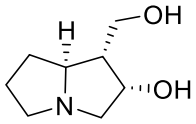
(b)  ; 

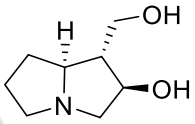
(c)  ; 
cycloocta-1,2-diene

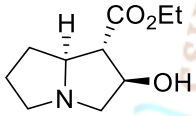
(d)  ; 
cycloocta-1,2-diene

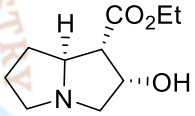
97. The major product formed in the following reaction is



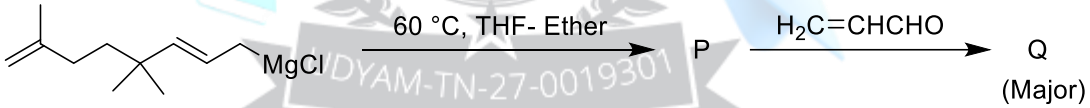
(a) 

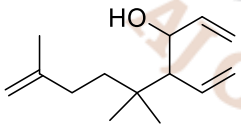
(b) 

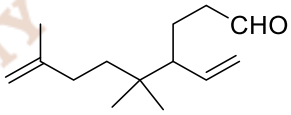
(c) 

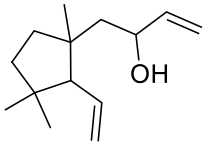
(d) 

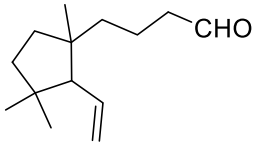
98. The structure of product Q formed in the following reaction sequence is



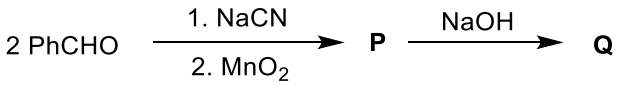
(a) 

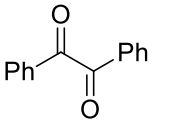
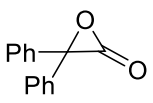
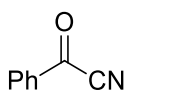
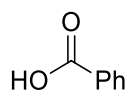
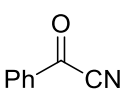
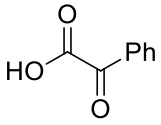
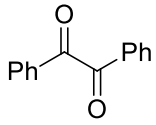
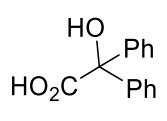
(b) 

(c) 

(d) 

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



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

100. Reaction of styrene ($PhCH{=}CH_2$) with HBr gives a mixture of Regioisomers X (major) and Y (minor). The ^{1}H-NMR spectrum of the mixture shows four signals, amongst others, at $\delta\ 5.17, 3.53, 3.15$ and 2.00 ppm with relative integration of $2:1:1:6$, respectively. The molar ratio of X and Y is

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

101. The energy functional from a trial wave function is $E(\alpha) = (\alpha^2 - 3\alpha)/6$. The variationally optimized energy is

(a) $-\frac{1}{2}$ (b) $-\frac{3}{8}$ (c) $\frac{3}{2}$ (d) $\frac{3}{8}$

102. A satisfactory spin wave function for an excited helium atom is

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

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

103. For a linear molecule the mean energies for translation, rotation ($T >> \theta_R$) and vibration ($T >> \theta_v$) follow ratio:

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

104. The highest energy π-molecular orbital for the allyl system is

(a) $\frac{1}{\sqrt{2}}\chi_1 + \frac{1}{2}\chi_2 + \frac{1}{\sqrt{2}}\chi_3$ (b) $\frac{1}{\sqrt{2}}\chi_1 - \frac{1}{\sqrt{2}}\chi_3$

(c) $\frac{1}{2}\chi_1 - \frac{1}{\sqrt{2}}\chi_2 + \frac{1}{2}\chi_3$ (d) $\frac{1}{\sqrt{2}}\chi_1 - \frac{1}{2}\chi_2 - \frac{1}{\sqrt{2}}\chi_3$

105. An unnormalized wave function of the hydrogen atom is given by $r^2 e^{-\frac{r}{3}}(3\cos^2\theta - 1)$. The three quantum numbers, n, l and m, associated with this orbital are, respectively

(a) 2, 2, 0 (b) 2, 1, 1 (c) 3, 2, 0 (d) 3, 1, 1

106. The π-orbital $p_1 + p_2 - p_3 - p_4$ of cis-butadiene belongs to the irreducible representation

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

(a) A_1 (b) A_2 (c) B_1 (d) B_2

107. The number of times the A_1 representation appears in the representation Γ of the

C_{2v} point group given below is

C_{2v}	E	C_2	σ_v	σ'_v
Γ	3	1	1	3

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

108. The populations of proton spins in the highest energy level of a sample in magnetic fields of 1.5 T and 7.0 T are N′ and N, respectively. The value of $\ln \frac{N'}{N}$ is

(γ, h, k, T are gyromagnetic ratio of the proton. Planck's constant, Boltzmann constant and temperature of the sample, respectively; assume that the partition functions for both systems can approximated as 1)

(a) $5.5\ \gamma\hbar/kT$ (b) $\frac{3}{14}\ \gamma\hbar/kT$ (c) $\frac{14}{3}\ \gamma\hbar/kT$ (d) $8.5\ \gamma\hbar/kT$

109. The difference between standard molar entropies of two mono-atomic gases X and Y $\left(S^0_{m,A} - S^0_{m,B}\right)$ at a given temperature is

(given that the molar mass of X is twice the molar mass of Y)

(a) $\frac{3}{2}R\ln 2$ (b) $R\ln 2$ (c) $\frac{5}{2}R\ln 2$ (d) $\frac{7}{2}R\ln 2$

110. A non-ideal gas follows the equation $P = \frac{RT}{V_m}\left[1 + \frac{B}{V_m}\right]$. The deviation in internal energy from that of an ideal gas, $U - U_{ideal}$, is given by

Where B is a function of temperature only.

(a) $\frac{-RT}{V_m}\left(\frac{\partial B}{\partial T}\right)_V$ (b) $\frac{-RT^2}{V_m}\left(\frac{\partial B}{\partial T}\right)_V$ (c) $\frac{-RT^2}{V_m}B$ (d) $\frac{-RT}{V_m}B$

111. The gas phase decomposition of A at 1000 K follows two decomposition paths

	Elementary Process	Rate constant
(i)	$A \longrightarrow B + C$	$3\ s^{-1}$
(ii)	$A \longrightarrow P + Q$	$5\ s^{-1}$

The maximum theoretical percentage yield of P at 1000 K is

(a) 62.5 (b) 60 (c) 166 (d) 37.5

112. Photochemistry of a molecule, M is described as by the mechanism

	Elementary process	Rate
(i)	$M + h\nu \longrightarrow M^*$	I_{abs}
(ii)	$M^* + Q \longrightarrow M + Q$	$k_Q[Q][M^*]$
(iii)	$M^* \longrightarrow M + h\nu_F$	$0.2[M^*]$

The intercept at $[Q] = 0$ is 4 for the inverse of fluorescence intensity $(1/I_F)$ vs $[Q]$

plot. The value of I_{abs} is

(a) 4 (b) 0.25 (c) 20 (d) 0.8

113. Above the critical micelle concentration(CMC), the option which correctly describes the variation of molar conductivity with increase in concentration of sodium dodecylsulphate in aqueous solution is

(a) molar conductivity increases sharply, but the solution does not remain colloidal

(b) molar conductivity decreases sharply, but the solution remains colloidal

(c) molar conductivity decreases sharply and dissociation into monomers also occurs sharply

(d) molar conductivity increases sharply with large loss of entropy

114. When two moles of liquid X are mixed with two moles of liquid Y at 300 K, the excess molar Gibbs energy of the solution is $-1.5\ \text{kJ mol}^{-1}$. The corresponding value of Gibbs energy of mixing (in kJ) is closest to $(R = 8.3\ \text{J K}^{-1}\text{mol}^{-1})$

(a) -12.9 (b) -6.0 (c) -1.5 (d) -0.9

115. A sample of 2.0 moles of $O_{2(g)}$ (assumed ideal) at 500 K is expanded from 5 L to 50 L under adiabatic and reversible conditions. The change in its internal energy (in kJ) is close to $\left(R = 8.3\ \text{J K}^{-1}\text{mol}^{-1};\ C_{V,m} = \frac{5}{2}R\right)$

(a) -22.5 (b) -12.5 (c) -19.1 (d) -7.5

116. The reaction rate of a self-catalyzed polyesterification reaction is given as $-\frac{d[COOH]}{dt} = k[COOH]^2[OH]$. If $[M]_0$ is the initial concentration of hydroxyl and carboxyl monomers, then the degree of polymerization, $\langle N\rangle$ is given by

(a) $\langle N\rangle = 2[M]_0^2kt$ (b) $\langle N\rangle^2 = 2[M]_0^2kt$

(c) $\langle N\rangle^2 = 2[M]_0^2kt + 1$ (d) $\langle N\rangle^2 = 2[M]_0kt + 1$

117. The correct relationship among the following for a tetragonal $(a = b \neq c; \alpha = \beta = \gamma = 90°)$ the crystal system is

(a) $\sin^2\theta = \frac{\lambda^2}{4a^2}[c^2(h^2 + k^2) + a^2l^2]$ (b) $\sin^2\theta = \frac{\lambda^2}{4a^2c^2}[c^2(h^2 + k^2) + a^2l^2]$

(c) $\sin^2\theta = \frac{\lambda^2}{4c^2}[a^2(h^2 + k^2) + c^2l^2]$ (d) $\sin^2\theta = \frac{\lambda^2}{4a^2}[h^2 + k^2 + l^2]$

118. If the overpotential of an electrolysis process is increased from 0.5 V to 0.6 V, then the ratio of current densities $\left(\ln\frac{j_{0.6}}{j_{0.5}}\right)$ of the electrolysis will be equal to

(given transfer co-efficient = 0.5)

(a) $0.5\frac{F}{RT}$ (b) $0.05\frac{F}{RT}$ (c) $0.1\frac{F}{RT}$ (d) $0.01\frac{F}{RT}$

119. **The chemical potential(μ) of a 2 molar Na_2SO_4 solution is expressed in terms of mean ionic activity co-efficient ($\gamma_\pm$) as**

(a) $\mu° + 5RT\ln 2 + 3RT \ln \gamma_\pm$ (b) $\mu° + 3RT\ln 2 + 3RT \ln \gamma_\pm$

(c) $\mu° + 3RT \ln \gamma_\pm$ (d) $\mu° + 4RT \ln \gamma_\pm$

120. **The Birge-Sponer plot between $\Delta G_{v+\frac{1}{2}} = (\varepsilon_{v+1} - \varepsilon_v)$ and $(v+1)$ for CO is a straight line with slope $-14\ cm^{-1}$ and intercept of $2170\ cm^{-1}$. The approximate value of dissociation energy of CO (in cm^{-1}) is,**

(Assume CO as an anharmonic oscillator with the energy expression $\varepsilon_v = \left(v+\frac{1}{2}\right)\omega - \left(v+\frac{1}{2}\right)^2 x_e\omega\ ; D = \frac{\omega}{4x_e}$)

(a) 42044 (b) 84088 (c) 168175 (d) 336350

Answer Key

PART - B

Q.No	Ans
21.	b
22.	b
23.	c
24.	c
25.	a
26.	a
27.	d
28.	a
29.	a
30.	d

Q.No	Ans
31.	c
32.	a
33.	c
34.	d
35.	a
36.	b
37.	a
38.	b
39.	a
40.	c

Q.No	Ans
41.	c
42.	b
43.	a
44.	b
45.	c
46.	c
47.	b
48.	c
49.	a
50.	a

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

PART - C

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

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

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

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