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

21. **For the given reaction, $[*Co(L)_n]^{2+} + [Co(L)_n]^{3+} \rightarrow [*Co(L)_n]^{3+} + [Co(L)_n]^{2+}$**

The correct statement with respect to the rate of electron transfer process is

(o-phen = o-phenanthroline; *Co is labeled atom)

(a) Fast electron transfer ; $L = NH_3$; $n = 6$

(b) Slow electron transfer ; L = o-phen ; $n = 3$

(c) Very slow electron transfer ; $L = NH_3$; $n = 6$

(d) Very slow electron transfer ; L = o-phen ; $n = 3$

22. **Choose the correct order of energy of $2\sigma_g$ and $1\pi_u$ molecular orbitals for B_2, C_2 and O_2:**

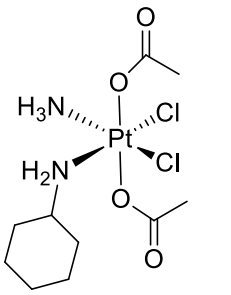
(a) $2\sigma_g > 1\pi_u$ for all the three (b) $2\sigma_g > 1\pi_u$ for B_2 and C_2 only

(c) $1\pi_u > 2\sigma_g$ for C_2 and O_2 only (d) $2\sigma_g > 1\pi_u$ for B_2 and O_2 only

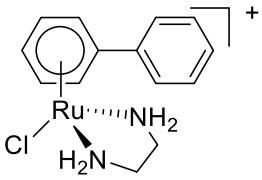
23. **The pair in which both actinides show +3 oxidation state only is**

(a) Ac and Lr (b) Ac and No (c) Cm and Bk (d) Cm and Lr

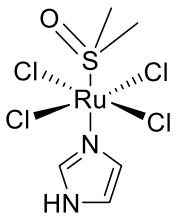
24. **The complex(es) showing activity against cancerous cells is/are**



P



Q



R

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

25. **Consider the nuclear reaction, Y is, $_{92}X^{234} + \beta + \alpha \rightarrow Y + \gamma + 2\beta^+$**

(a) $_{92}Y^{238}$ (b) $_{91}Y^{238}$ (c) $_{91}Y^{236}$ (d) $_{94}Y^{238}$

26. **Correct statements among the following with respect to ionization energy (IE) is/are**

[P] $(IE_1 + IE_2 + IE_3)$ for indium is more than that of aluminium

[Q] IE_1 of scandium is higher than that of cobalt

[R] IE_1 of gallium is lower than that of selenium

[S] IE_1 of nitrogen is greater than that of oxygen

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

27. **The reason for significantly high solubility of $AgClO_4$ in benzene than in alkane solvents is**

(a) Alkane solvents are non-polar (b) Benzene is an aprotic solvent

(c) PhAg is formed (d) Benzene acts as a soft base

28. **Correct statement for 'Inductively Coupled Plasma Atomic Emission Spectroscopy' is**

(a) It is unsuitable for all non-metals

(b) Simultaneous determination of only metals is possible

(c) Induction coil stabilizes plasma

(d) Oxide formation lowers atomization of metals

29. **The number of geometrical isomers of the complex $[RhH(C{\equiv}CR)_2(PMe_3)_3]$ is**

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

30. **I_2 is violet in the solid as well as in gas phase. However in acetone or ethanol, it turns brown. Choose the correct statement(s) for this colour change:**

[P] Dissociation of I_2 in atomic state

[Q] Interaction of low-lying σ^*-orbital of iodine with lone pair of O (solvent)

[R] Formation of a charge-transfer complex

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

31. **The pair of compounds in which both members show LMCT band in their electronic spectra is**

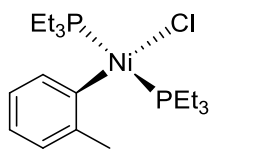
(a) $[FeCl_4]^{2-}$ and $[Fe(bpy)_3]^{2+}$ (b) $[FeBr_4]^{2-}$ and $[TcO_4]^-$

(c) $[ReO_4]^-$ and $[Ru(bpy)_3]^{2+}$ (d) $[Fe(phen)_3]^{2+}$ and $[FeCl_4]^{2-}$

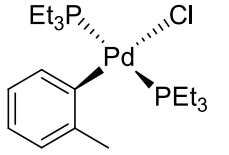
32. **During the binding of O_2 to myoglobin (consider 'heme' in xy-plane), the molecular orbital of O_2 and atomic orbital of Fe involved in the formation of the σ-bond is**

(a) π^* and dz^2 (b) π^* and d_{xz} (c) π and d_{xz} (d) π and dz^2

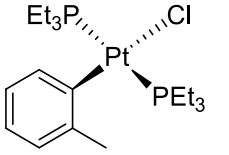
33. **The order of rate of substitution of chloride by pyridine (in ethanol) in the following complexes is**



I



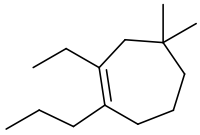
II



III

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

34. **The correct IUPAC name for the following molecule is**



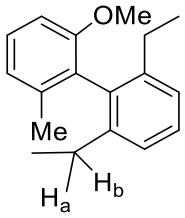
(a) 1-Propyl-2-ethyl-4,4-dimethylcyclohept-1-ene

(b) 2-Ethyl-4,4-dimethyl-1-propylcyclohept-1-ene

(c) 3-Ethyl-1,1-dimethyl-4-propylcyclohept-3-ene

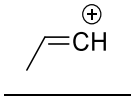
(d) 1,1-Dimethyl-3-ethyl-4-propylcyclohept-3-ene

35. The stereochemical relationship of H_a and H_b in the following molecule is

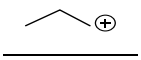


(a) enantiotopic (b) homotopic (c) diastereotopic (d) constitutionally heterotopic

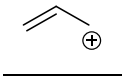
36. The correct order of stability of the carbocations P-R is



P



Q

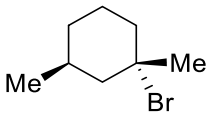


R

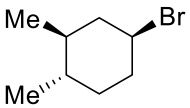
(a) R > P > Q (b) P > R > Q

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

37. The correct statement for the orientation of the bromine atoms in the most stable conformations of P and Q is



P

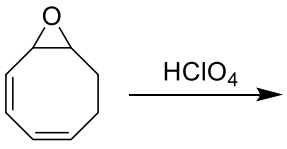


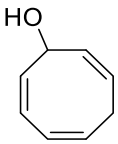
Q

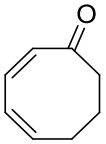
(a) axial in both P and Q (b) axial in P and equatorial in Q

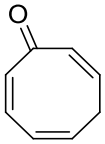
(c) equatorial in both P and Q (d) equatorial in P and axial in Q

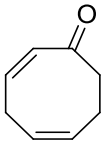
38. The major product formed in the following reaction is



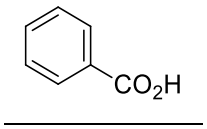
(a) 

(b) 

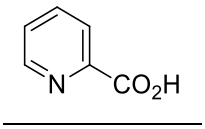
(c) 

(d) 

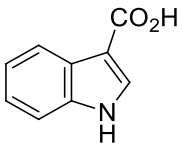
39. The following carboxylic acids undergo decarboxylation upon heating. The ease of decarboxylation is in the order



P



Q



R

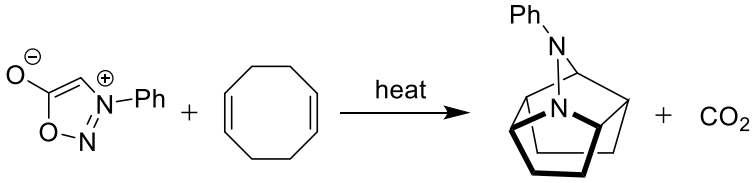
(a) Q > P > R (b) R > Q > P

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

40. The HOMO of π-molecular orbitals of methylazide is

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

41. The following transformation involves a series of



(a) electrocyclic ring-opening and closing reactions

(b) cycloaddition and cycloreversion reactions

(c) sigmatropic rearrangements

(d) cheletropic addition and elimination reactions

42. The synthetic equivalent of the given synthon is

(a) t-butyl isocyanide (b) t-butyl cyanide (c) t-butyl cyanate (d) t-butyl isocyanate

43. The correct order of the pK_a of the following compounds is

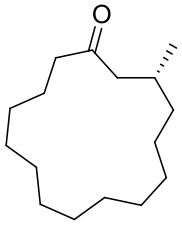
P

Q

R

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

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

44. 

Muscone is a

(a) terpenoid

(b) steroid

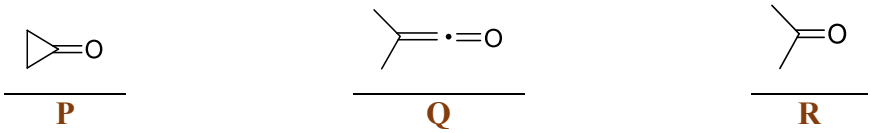
(c) polyketide

(d) flavonoid

45. **The natural product that gives a signal at δ 218 ppm in its ^{13}C-NMR spectrum is**

(a) α-pinene (b) camphor (c) geraniol (d) carvone

46. **The correct order of carbonyl stretching frequency for the given compounds is**



P **Q** **R**

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

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

47. **The expectation value of p^2 of a particle in a cubic box of side l, having the wavefunction $\varphi_{n_x,n_y,n_z}(x,y,z) = \left(\frac{2}{l}\right)^{3/2} \sin\frac{2\pi x}{l}\sin\frac{3\pi y}{l}\sin\frac{2\pi z}{l}$, is**

(a) $\frac{17h^2}{4l^2}$ (b) $\frac{7h^2}{4l^2}$ (c) $\frac{3h^2}{l^2}$ (d) $\frac{13h^2}{4l^2}$

48. **For the d^3 electron configuration, the ground state term symbol is**

(a) $^4F_{1/2}$ (b) $^4F_{3/2}$ (c) $^4F_{7/2}$ (d) $^4F_{9/2}$

49. **The total bond order between adjacent carbon atoms of benzene is**

(a) 0.5 (b) 2 (c) 1.5 (d) 2.5

50. **The following is the character table for the C_{2v} point group**

C_{2v}	E	C_2	σ_v	σ_v'
A_1	1	1	1	1
A_2	1	1	−1	−1
B_1	1	−1	1	−1
B_2	1	−1	−1	1

There are two functions f_1 and f_2 belonging to A_2 and B_1 representations, respectively. The correct option for the product of two functions f_1 and f_2 and the integral $\int f_1 f_2 d\tau$ is

(a) The product belongs to A_2 representation and the integral is non-zero

(b) The product belongs to B_2 representation and the integral is zero

(c) The product belongs to A_1 representation and the integral is zero

(d) The product belongs to B_1 representation and the integral is non-zero

51. **The equilibrium dissociation energy of a diatomic molecule is $4.75\ eV$ and its stretching frequency corresponds to $0.5\ eV$. The minimum energy required to dissociate the molecule in eV is**

(a) 4.75 (b) 4.25 (c) 4.50 (d) 5.00

52. **The monatomic perfect gas undergoes expansion from (p_1, V_1) to (p_2, V_2) under isothermal or adiabatic conditions. The pressure of the gas will fall more rapidly under adiabatic conditions because**

(a) $p \propto \frac{1}{V}$ (b) $p \propto \frac{1}{V^{7/5}}$ (c) $p \propto \frac{1}{V^{3/2}}$ (d) $p \propto \frac{1}{V^{5/3}}$

53. **For the reaction $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$, the thermodynamic quantity which depends upon the pressure at which equilibrium is arrived at is _____**

(superscript 'o' represents standard state)

(a) ΔG° (b) ΔH° (c) K_P (d) ratio of mole fractions, $\frac{x^2_{NH_3}}{x_{N_2} x^3_{H_2}}$, at equilibrium

54. **The $E^{\circ}(M^+/M)$ of the cell, SHE ‖ MX | M can be obtained from the plot of _____**

(E_{cell} is the cell potential and m is the molality of ideal dilute solution of MX)

(a) E_{cell} against $(T \log m)$ (b) E_{cell} against $\left(\frac{1}{T} \log m\right)$

(c) E_{cell} against $(T\sqrt{m})$ (d) E_{cell} against $\left(\frac{\sqrt{m}}{T}\right)$

55. **The y-intercept obtained from the plot of viscosity of a series of polymer solutions against the concentration is 0.05. The proportionality constant K and exponent a for this polymer-solvent pair are 5×10^{-5} and 0.5, respectively. The molar mass of the polymer in $g\ mol^{-1}$ is**

(a) 10^9 (b) 10^5 (c) 10^6 (d) 10^7

56. **In the ccp packing, the number of lattice points per units area in the planes is in the order**

(a) (100) > (110) > (111) (b) (100) > (111) > (110)

(c) (111) > (100) > (110) (d) (111) > (110) > (100)

57. **The correct statements about chemisorption is**

(a) Chemisorption results in multi molecular layer adsorption

(b) Chemisorption is reversible in nature

(c) Chemisorption has lower specificity than physisorption

(d) Chemisorption occurs due to formation of chemical bonds

58. **For a reaction, raising the temperature from 200 K to 300 K results in the increase of rate constant by a factor of 2. The activation energy for this reaction kJ mol^{-1} is closest to ($\ln 2 = 0.69$)**

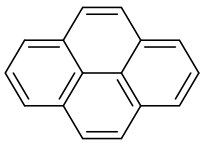
(a) 7.0 (b) 3.5 (c) 14.0 (d) 0.83

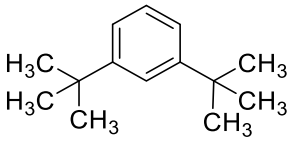
59. **The y-intercept of the least square fitted straight line to the data in the table is closest to**

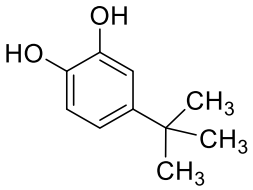
x	−2.01	−0.98	1.01	1.99
y	−4.01	−1.98	2.01	3.99

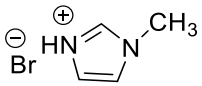
(a) −0.2 (b) −0.1 (c) 0 (d) 0.2

60. **The guest molecule which will fit best inside α-cyclodextrin by interacting with both, rim and cavity, is**

(a) 

(b) 

(c) 

(d) 

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

61. **Among the following complexes, the one showing the highest rate of substitution of a CO ligand on heating with one equivalent of PPh_3 in decalin, is**

(a) $(\eta^5\text{-}C_5H_5)Mn(CO)_3$ (b) $(\eta^5\text{-}C_5Ph_5)Mn(CO)_3$

(c) $(\eta^5\text{-}C_5Me_5)Mn(CO)_3$ (d) $(\eta^5\text{-indenyl})Mn(CO)_3$

62. **The correct electronic configuration of frontier MO's of $Mn(\eta^5\text{-}C_5Me_5)_2$ is**

(a) $e_{2g}^2 a_{1g}^1 e_{1g}^2$ (b) $e_{2g}^4 a_{1g}^1$ (c) $e_{2g}^3 a_{1g}^2$ (d) $a_{1g}^2 e_{2g}^3$

63. **On heating $[Mo(N_2)_2(PMe_2Ph)_4]$ and $[ReCl(N_2)(PMe_2Ph)_4]$, the products formed are respectively**

(a) $[(\eta^6\text{-}PhPMe_2)Mo(PMe_2Ph)_3]$ and $[(\eta^6\text{-}PhPMe_2)Re(PMe_2Ph)_3]Cl$

(b) $[(PMe_2Ph)_4Mo(\mu\text{-}N_2)_2Mo(PMe_2Ph)_4]$ and $[(PMe_2Ph)_4Re(\mu\text{-}Cl)_2Re(PMe_2Ph)_4]$

(c) $[(\eta^6\text{-}PhPMe_2)Mo(PMe_2Ph)_3]$ and $[(PMe_2Ph)_4Re(\mu\text{-}Cl)_2Re(PMe_2Ph)_4]$

(d) $[(PMe_2Ph)_4Mo(\mu\text{-}N_2)_2Mo(PMe_2Ph)_4]$ and $[(\eta^6\text{-}PhPMe_2)Re(PMe_2Ph)_3]Cl$

64. The products P and Q for the given reaction are, respectively

$[Co(NH_3)_5Cl]^{2+} + [Cr(OH_2)_6]^{2+} + 5H_3O^+ \longrightarrow P + Q$

	P		Q
(a)	$[Co(OH_2)_5Cl]^+$	;	$[Cr(OH_2)_6]^{3+}$
(b)	$[Co(NH_3)_5(OH_2)]^{2+}$	;	$[Cr(OH_2)_5Cl]^{2+}$
(c)	$[Co(OH_2)_6]^{2+}$	;	$[Cr(OH_2)_5Cl]^{2+}$
(d)	$[Co(NH_3)_5Cl]^+$	;	$[Cr(OH_2)_6]^{3+}$

65. The calculated heat of formation (ΔH_f) for $NaCl_2$ and CaF is

(a) negative for both $NaCl_2$ and CaF

(b) negative for $NaCl_2$ but positive for CaF

(c) positive for $NaCl_2$ but negative for CaF

(d) positive for both $NaCl_2$ and CaF

66. As per the VSEPR theory, shapes of SO_3^{2-}, CO_3^{2-} and BrF_4^- are, respectively

(a) trigonal pyramidal , trigonal planar and tetrahedral

(b) trigonal planar , trigonal pyramidal and Square planar

(c) trigonal pyramidal , trigonal planar and Square planar

(d) trigonal planar , trigonal pyramidal and tetrahedral

67. Consider the following statements for Allred-Rochow electronegativity (χ_{AR}):

[P] χ_{AR} is directly proportional to Z_{eff}

[Q] χ_{AR} is inversely proportional to Z_{eff}

[R] χ_{AR} is inversely proportional to r (covalent)

[S] χ_{AR} is inversely proportional to r^2 (covalent)

The correct statements are

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

68. The reaction of XeF_6 with a limited amount of quartz gives compound X. Then on reaction with an equivalent amount of XeO_3. X gives Y. The products X and Y are,

respectively

(a) $XeOF_2$ and XeO_2F_2 (b) $XeOF_4$ and XeO_2F_2

(c) $XeOF_2$ and $XeOF_4$ (d) XeO_2F_2 and $XeOF_4$

69. The energies of given interactions are inversely proportional to

Ion pair interactions	Ion-dipole interactions	Dipole-dipole interactions
I	II	III

(a) r, r^2 and r^3 respectively (b) r^2, r and r^3 respectively

(c) r, r^2 and r^6 respectively (d) r^2, r and r^6 respectively

70. The correct match for column-I with column-II is:

	Column-I		Column-II
P	f ↛ f transition	i.	Tb^{3+}
Q	$^5D_0 \rightarrow {}^7F_n$ emission	ii.	Lu^{3+}
R	$^5D_4 \rightarrow {}^7F_n$ emission	iii.	Sm^{3+}
S	Overlapping J levels	iv.	Eu^{3+}

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

71. Thermometric titration gives best results when

[P] $|\Delta H|$ **is high**

[Q] $\Delta G < 0$

[R] Heat of mixing of titrant with titrand is high

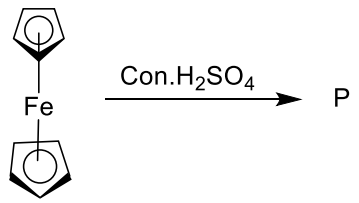
[S] Titrant is used as dilute solution

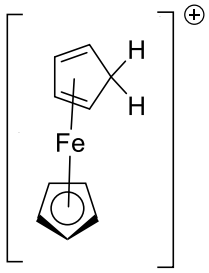
(a) P and Q (b) Q and R (c) R and S (d) P and S

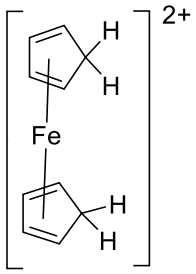
72. The geometry/shape of the Fe_4 core of the cluster $[Fe_4C(CO)_{12}]^{2-}$ is

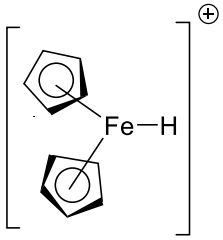
(a) tetrahedron (b) square pyramid (c) butterfly (d) trigonal bipyramid

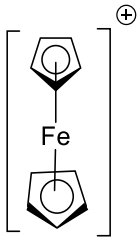
73. The product-P of the following reaction is



(a) 

(b) 

(c) 

(d) 

74. **The number of peaks with relative intensities observed in the ^{1}H-NMR spectra of $[(Cp)_2Fe(CO)_2]$ at $+30°$ and -80 °C in diethyl ether are, respectively**

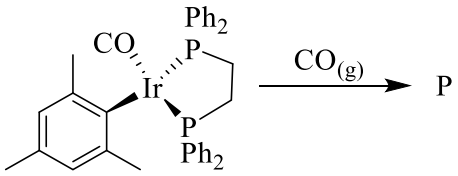
(a) two peaks (1 : 1) and four peaks (5 : 2 : 2 : 1)

(b) one peak and two peaks (1 : 1)

(c) two peaks (1 : 1) at both temperatures

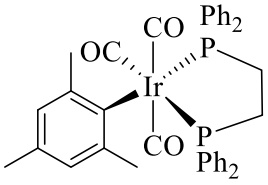
(d) one peak and four peaks (5 : 2 : 2 : 1)

75. **The infrared (IR) spectrum of the product "P" for the following reaction**

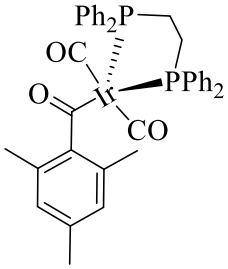


Shows three STRONG bands at 1986, 1935 and 1601 cm^{-1}. The correct structure of 'P' is

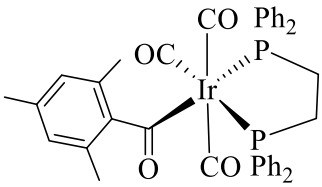
(a)



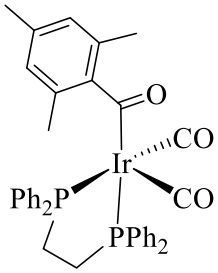
(b)



(c)



(d)



76. **The number of expected electronic transitions in $[Cr(en)_3]^{3+}$ and trans-$[Cr(en)_2F_2]^+$ at 4K is, respectively (en = ethylenediamine)**

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

77. **The value of magnetic moment will be independent of temperature for**

(acac = acetylacetonato; OAc = acetate; o-phen = o-phenanthroline; Pz = pyrazolyl)

(a) $[Fe(acac)_3]$ (b) $[Cu_2(OAc)_4(H_2O)_2]$

(c) $[Fe(o\text{-}phen)_2(NCS)_2]$ (d) $[Fe\{HC(3,5\text{-}Me_2Pz)_3\}_2]^{2+}$

78. **Choose the correct statements for the Group 15 halides:**

[P] $AsCl_3$ can form complexes of type $[AsCl_4]^-$ in the presence of a chloride

source

[Q] PF_3 acts as a strong σ-donor ligand towards d-metals

[R] In the solid state, SbF_5 has a trigonal bipyramidal structure

[S] The reaction of SbF_5 with anhydrous HF generates $[H_2F]^+$ ions

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

79. In the catalytic cycle of cytochrome-P450, the generation of $[(porphyrin)^{\bullet+}Fe^{IV}(O)]$ from $[(porphyrin)Fe^{III}(OOH)]$ involves

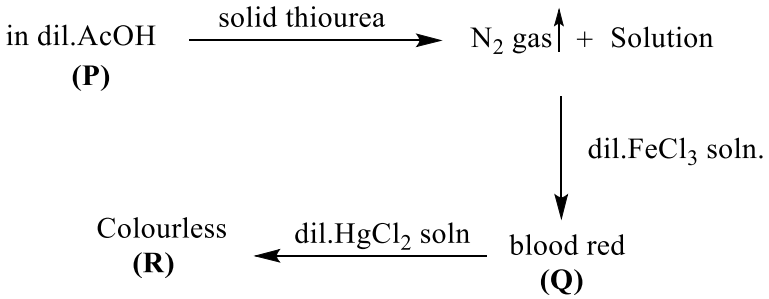
(a) One electron oxidation of $[(porphyrin)Fe^{III}(OOH)]$

(b) Formation of the intermediate $[(porphyrin)Fe^{IV}(OH)]$

(c) Homolytic O-O cleavage of $[(porphyrin)Fe^{IV}(OOH)]$

(d) Heterolytic O-O cleavage of $[(porphyrin)Fe^{III}(OOH)]$

80. In the following sequence of reactions, the correct P, Q and R are respectively



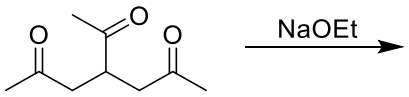
(a) $KNO_2, CO_2, [Fe(H_2O)_5S]^+, HgS$

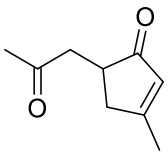
(b) $KNO_2, N_2, [Fe(H_2O)_5(SCN)]^{2+}, [Hg(SCN)_4]^{2-}$

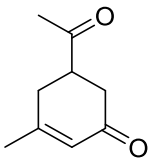
(c) $KNO_3, N_2, [Fe(H_2O)_5(CN)]^{2+}, [Hg(OCN)_4]^{2-}$

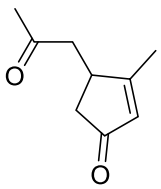
(d) $NaN_3, N_2, [Fe(H_2O)_5(N_3)]^{2+}, [Hg(N_3)_4]^{2-}$

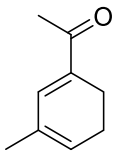
81. The major product formed in the following reaction is



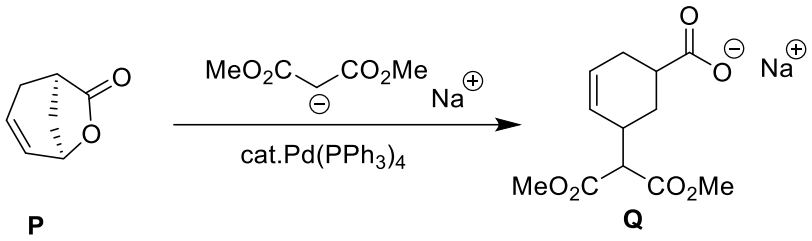
(a) 

(b) 

(c) 

(d) 

82. In the following transformation, the enantiomerically pure lactone (P) provides



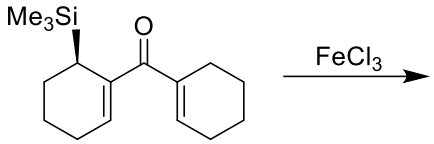
(a) equimolar amounts of syn-and anti-diastereomers of Q, both of which are racemic

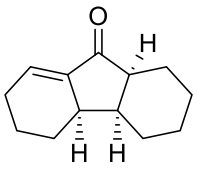
(b) equimolar amounts of syn-and anti-diastereomers of Q, both of which are enantiomerically pure

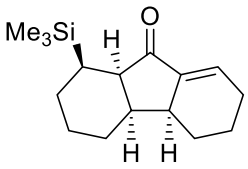
(c) only syn-diastereomer of Q, which is racemic

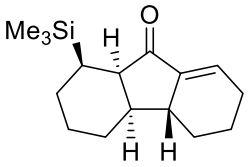
(d) only anti-diastereomer of Q, which is enantiomerically pure

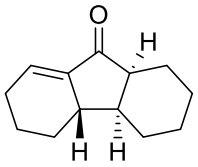
83. The major product formed in the following transformation is



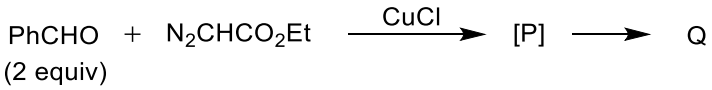
(a) 

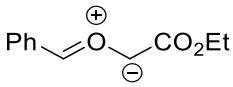
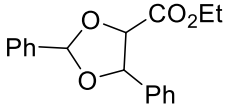
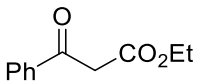
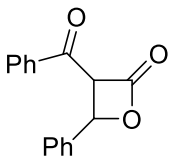
(b) 

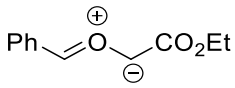
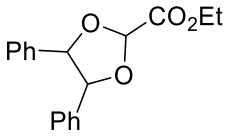
(c) 

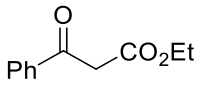
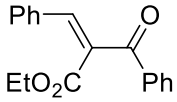
(d) 

84. In the given transformation, the intermediate [P] and the major product Q are

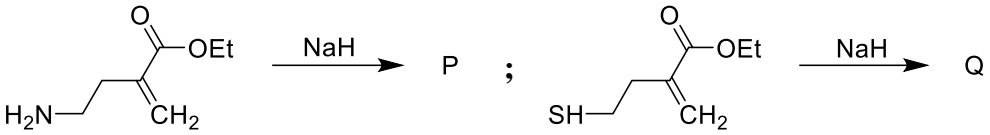


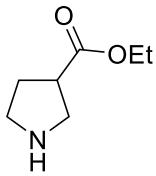
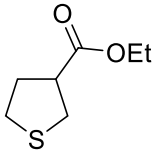
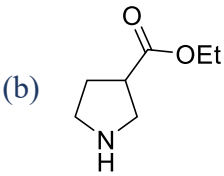
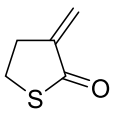
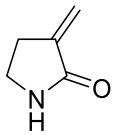
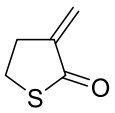
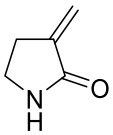
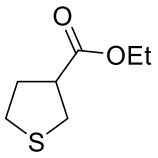
	P	Q
(a)		
(b)		

(c)  ; 

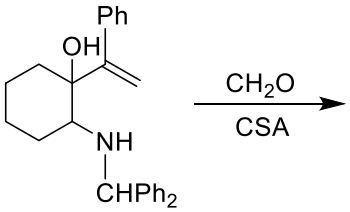
(d)  ; 

85. The major products P and Q formed in the following transformations are

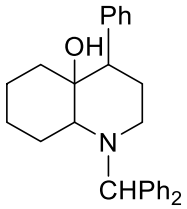


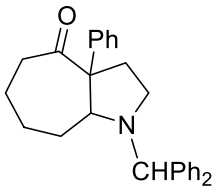
P	Q
(a)  ;	
(b)  ;	
(c)  ;	
(d)  ;	

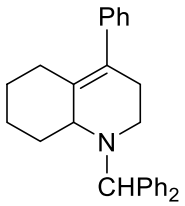
86. The major product formed in the following reaction is

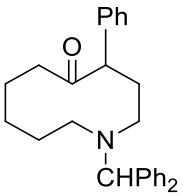


CSA = Camphorsulfonic Acid

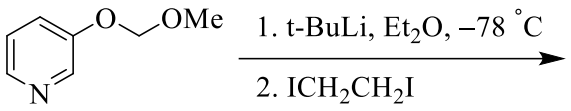
(a) 

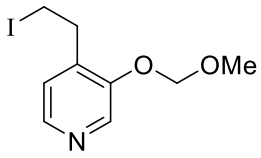
(b) 

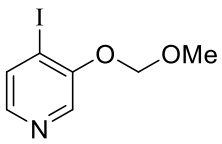
(c) 

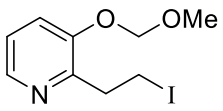
(d) 

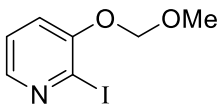
87. The major product formed in the following reaction sequence is



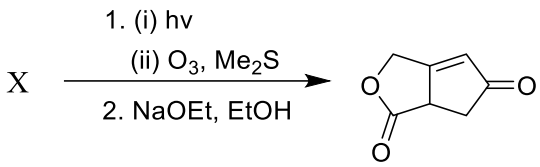
(a) 

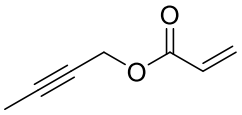
(b) 

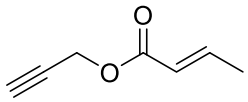
(c) 

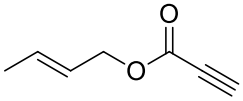
(d) 

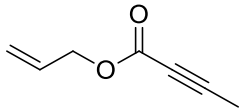
88. The structure of X in the following reaction is



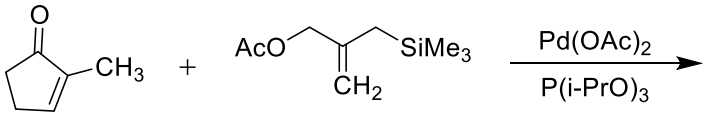
(a) 

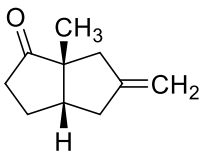
(b) 

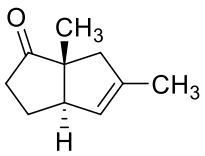
(c) 

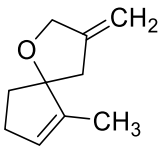
(d) 

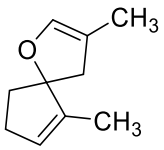
89. The major product formed in the following reaction is



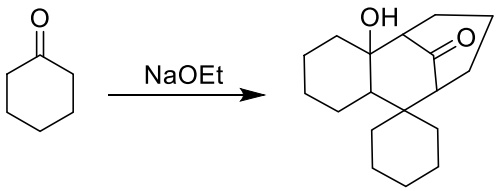
(a) 

(b) 

(c) 

(d) 

90. The correct sequence of reactions involved in the following transformation is



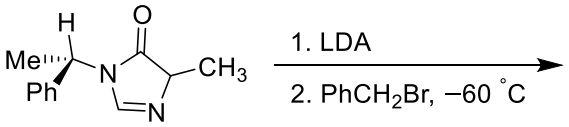
(a) Aldol condensation , Michael addition , Aldol reaction

(b) Aldol condensation , Aldol reaction , Michael addition

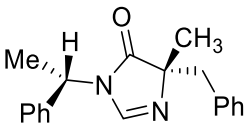
(c) Michael addition , Aldol condensation , Aldol reaction

(d) Aldol condensation , Michael addition , Michael addition

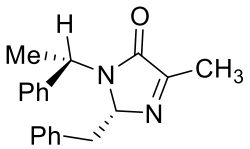
91. The major product formed in the following reaction is



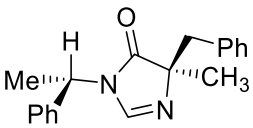
(a)



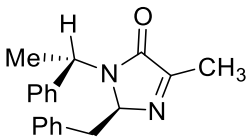
(b)



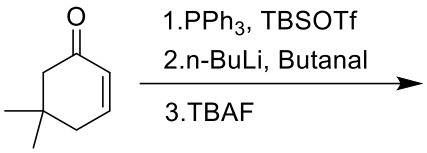
(c)



(d)



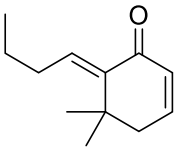
92. The major product formed in the following reaction is



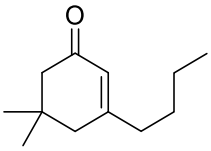
TBSOTf = t-Butyldimethylsilyl triflate

TBAF = tetra-n-butylammonium fluoride

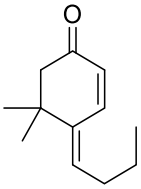
(a)



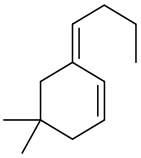
(b)



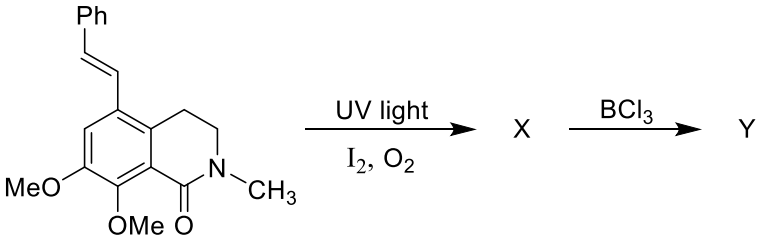
(c)



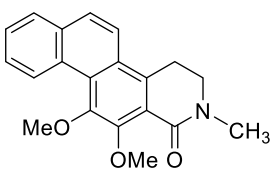
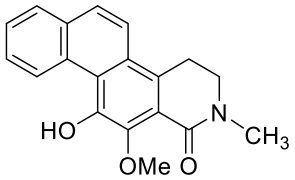
(d)

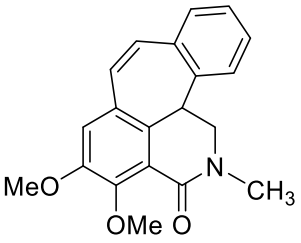
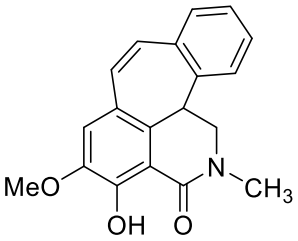


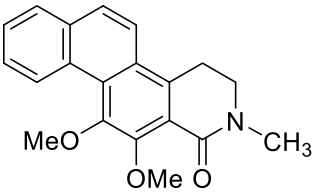
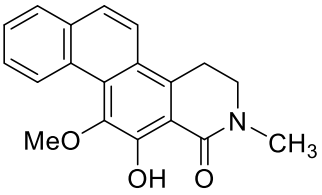
93. The major products X and Y formed in the following reactions are

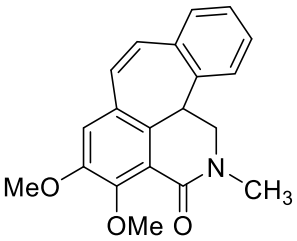
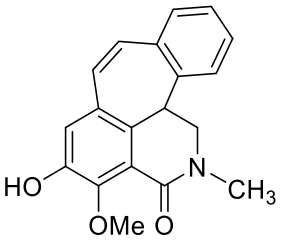


X **Y**

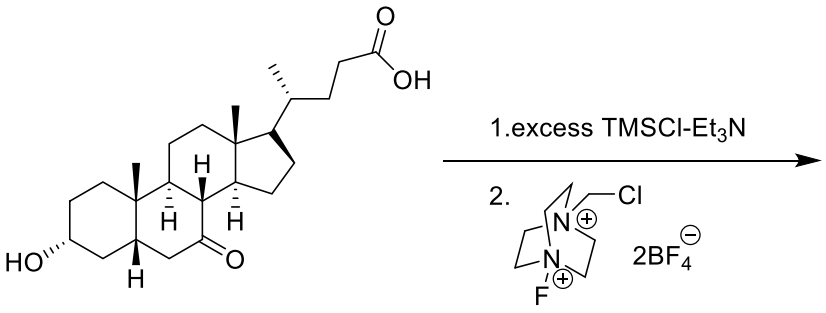
(a)  ; 

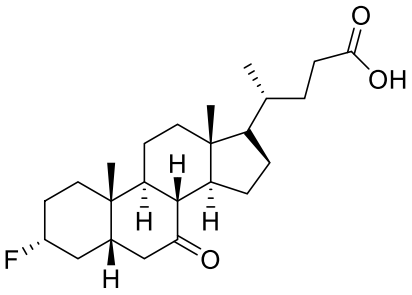
(b)  ; 

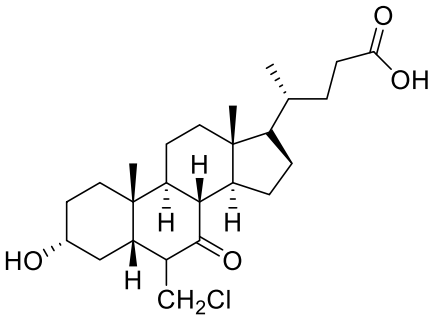
(c)  ; 

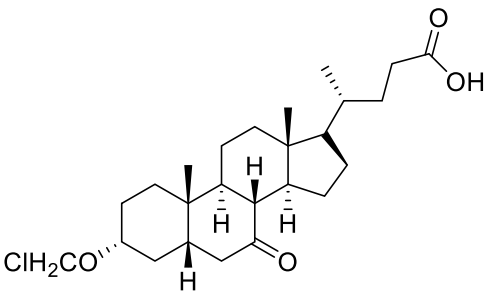
(d)  ; 

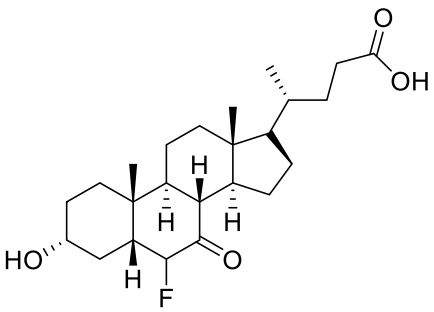
94. The major product formed in the following reaction is



(a) 

(b) 

(c) 

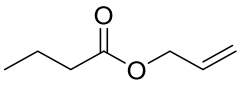
(d) 

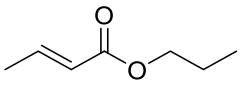
95. The compound that exhibits the following spectral data is

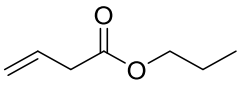
IR (ν_{max}) : $1740 cm^{-1}$

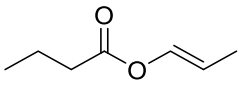
^{1}H-NMR (δ) : 0.9 (t, 3H), 1.6 (sext, 2H), 2.3 (t, 2H), 4.6 (d, 2H), 5.2 (d, 1H), 5.4 (d, 1H), 5.9 (m, 1H)

EI-MS : 71(100%)(m/z)

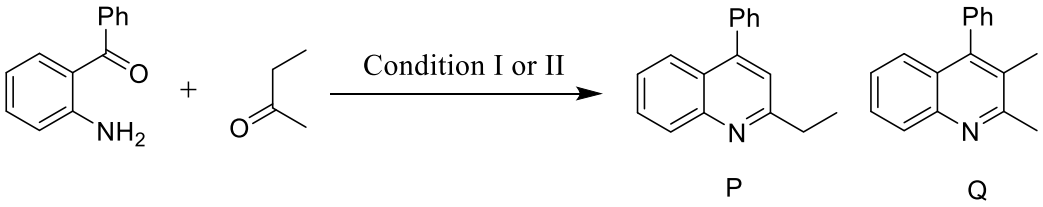
(a) 

(b) 

(c) 

(d) 

96. The correct statement for the following transformation is



Condition I : aq.KOH, EtOH, 0 ℃

Condition II : H_2SO_4, AcOH, reflux

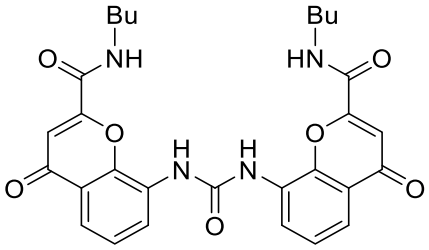
(a) P is preferentially formed via condition I, under thermodynamic control

(b) Q is preferentially formed via condition II, under thermodynamic control

(c) P is preferentially formed via condition II, under kinetic control

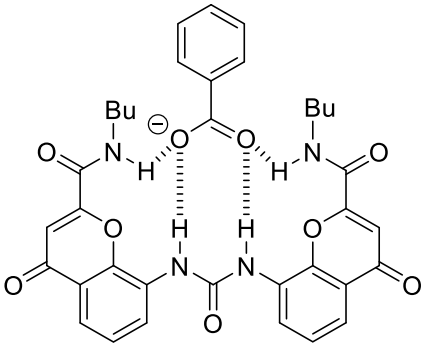
(d) Q is preferentially formed via condition I, under kinetic control

97. The correct depiction of the strongest hydrogen bonded complex between benzoate anion and receptor X is

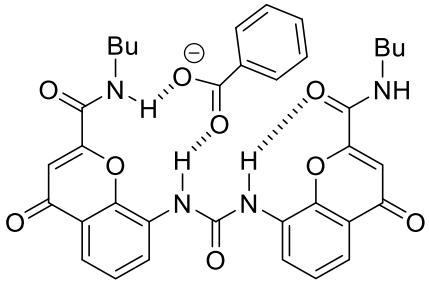


X

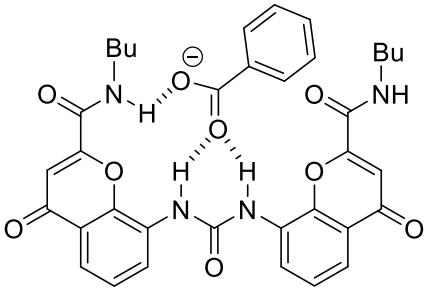
(a)



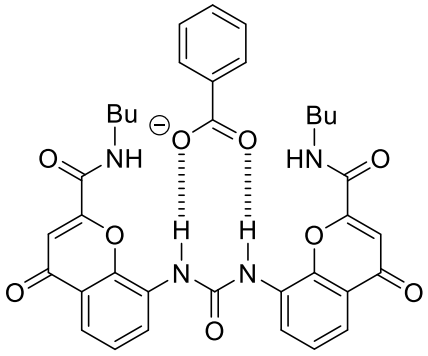
(b)



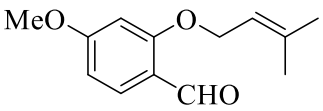
(c)



(d)

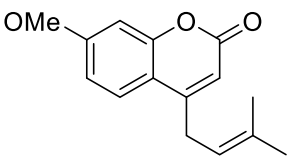


98. The major product formed in the following reaction sequence is

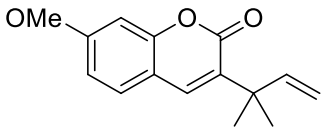


1. $Ph_3P{=}CHCO_2Et$
2. heat, >200 °C

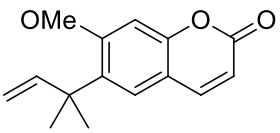
(a)



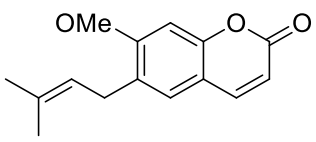
(b)



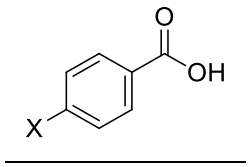
(c)



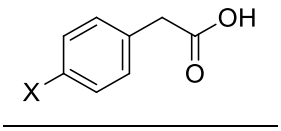
(d)



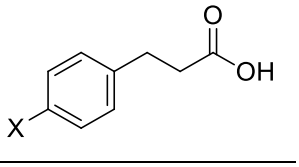
99. The correct order for the Hammett Reaction constant (ρ) for the deprotonation of the following carboxylic acids is



P



Q

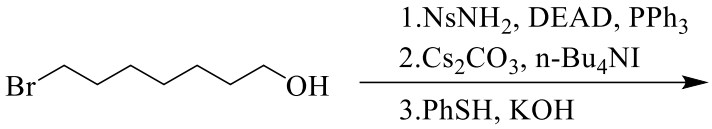


R

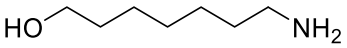
(a) Q > R > P (b) R > P > Q

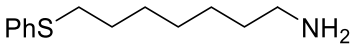
(c) P > Q > R (d) P > R > Q

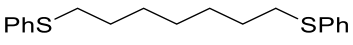
100. The major product formed in the following reaction sequence is

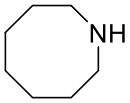


NS = 2-Nitrobenzenesulfonyl & DEAD = Diethyl azodicarboxylate

(a) 

(b) 

(c) 

(d) 

101. Let the Hemiltonian H, in one-dimension, be

$$H = \frac{p_x^2}{2m} + V(x)$$

The commutator of H with x, [H, x], is

(a) $\frac{-i\hbar}{m}p_x$ (b) $\frac{-i\hbar}{2m}p_x^2$ (c) $\frac{i\hbar}{m}p_x$ (d) $\frac{i\hbar}{2m}p_x$

102. For an electron in 1s orbital of He^+, the average value of r, $\langle r \rangle$ is

(a) $\frac{3}{2}a_0$ (b) $\frac{3}{4}a_0$ (c) $3a_0$ (d) $\frac{1}{2}a_0$

103. Consider a particle on a ring that is perturbed by interacting with an applied electric field (E) with the perturbation being $H' = \mu E \cos\phi$, where μ is the dipole moment. The energy levels correct upto first order are

(a) $\frac{m_l^2 h^2}{2} - \frac{\mu E}{\pi}$ (b) $\frac{m_l^2 h^2}{2I} - \frac{\mu E}{2\pi}$ (c) $\frac{m_l^2 h^2}{2I} + \frac{\mu E}{2\pi}$ (d) $\frac{m_l^2 h^2}{2I}$

104. For a model system of three non-interacting electrons confined in a two-dimensional square box of length L, the ground state energy in units of $\left(\frac{h^2}{8mL^2}\right)$ is

(a) 14 (b) 6 (c) 4 (d) 9

105. The term symbol for the ground state of dinitrogen cation radical (N_2^+) is

(a) $^2\Pi_u$ (b) $^2\Sigma_u^-$ (c) $^2\Pi_g$ (d) $^2\Sigma_g^+$

106.

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

The observed IR spectrum for BCl_3 exhibits three bands at $995, 480$ and $244 cm^{-1}$, while the Raman bands are observed at $995, 471$ and $244\ cm^{-1}$. Given that for $BCl_3, \Gamma_{vib} = A_1' + 2E' + A_2''$, the frequency of A_1' mode in cm^{-1} is

(a) 244 (b) 471 (c) 480 (d) 995

107. Given the matrices for C_3 and σ_h below,

$$C_3 = \begin{bmatrix} -1/2 & -\sqrt{3}/2 & 0 \\ \sqrt{3}/2 & -1/2 & 0 \\ 0 & 0 & 1 \end{bmatrix}; \sigma_h = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

The trace of the matrix representing for S_3^2 is

(a) 0 (b) −2 (c) 1 (d) −1

108. The energy separation of $^{12}C^{16}O$ rotational energy levels between $J'' = 3$ and $J'' = 9$ is $24\ cm^{-1}$. The rotational constant of $^{13}C^{16}O$ in cm^{-1} is closest to

(a) 2.98 (b) 0.88 (c) 1.90 (d) 2.08

109. The vibrational transition energies of a diatomic molecule corresponding to $\nu = 1 \leftarrow \nu = 0$ and $\nu = 2 \leftarrow \nu = 1$ are $2143.1\ cm^{-1}$ and $2116.1\ cm^{-1}$, respectively. The anharmonic constant($\omega_e x_e$) of the molecule in cm^{-1} is

(a) 27 (b) 13.5 (c) 10 (d) 54

110. The change in chemical potential (in J) of one mole of an ideal gas, when it is compressed isothermally at 300 K from 1.0 atm to 2.0 atm, is closest to

(a) 1225 (b) 1725 (c) 2425 (d) 2725

111. The excess molar entropy of mixing of liquid P with liquid Q is $-R \ln 2$. The experimentally observed change in entropy upon mixing 1.0 mol of liquid P with 1.0 mol of liquid Q is

(a) $-2R \ln 2$ (b) $+4R \ln 2$ (c) 0 (d) $+R \ln 2$

112. The entropy in terms of internal energy $\{U - U(0)\}$, and canonical partition function (Q) is given by $S = \frac{U-U(0)}{T} + k \ln Q$. Assuming that the atoms are distinguishable, the corresponding expression for a monatomic perfect gas is

[Here n, m, N_A, k and h represent number of moles, mass of atoms, Avogadro constant, Boltzmann constant and planck constant, respectively. $U(0)$ is internal energy at $T = 0$].

(a) $S = \frac{5}{2}nR + n\,R \ln\left\{\frac{V(2\pi\, mkT)^{3/2}}{nN_A h^3}\right\}$ (b) $S = \frac{3}{2}nR + n\,R \ln\left\{\frac{V(2\pi\, mkT)^{3/2}}{h^3}\right\}$

(c) $S = \frac{5}{2}nR + n\,R \ln\left\{\frac{V(2\pi\, mkT)^{\frac{3}{2}}}{h^3}\right\}$ (d) $S = \frac{3}{2}nR + n\,R \ln\left\{\frac{V(2\pi\, mkT)^{3/2}}{nN_A h^3}\right\}$

113. For a Vander Walls gas, the partial derivative $\left(\frac{\partial U}{\partial V}\right)_T$ is

(a) $\frac{V_m}{a}$ (b) $\frac{V_m^2}{a}$ (c) $\frac{a}{V_m^2}$ (d) $\frac{a}{V_m}$

114. An aqueous solution contains $0.02\ mol\ kg^{-1}$ NaCl and $0.03\ mol\ kg^{-1}$ $Ca(NO_3)_2$. The logarithm of the mean ionic activity coefficient$(\log \gamma_{\pm})$ of this solution at $25\ ^{\circ}C$ is

(a) $-\sqrt{0.095}$ (b) $\sqrt{0.154}$ (c) $-\sqrt{0.033}$ (d) $-\sqrt{0.11}$

115. Molar conductivities of an electrolyte are 100 and $50\ mS\ cm^2 mol^{-1}$ when concentrations are 4 and $9\ mM$, respectively. The limiting molar conductivity of this electrolyte in $mS\ cm^2 mol^{-1}$ is closest to

(a) 150 (b) 200 (c) 250 (d) 300

116. The concentration(C) of a compound undergoing decomposition as a function of time (t) is given below:

t/min	0	1	2	4	6
C/M	1.00	0.80	0.67	0.50	0.40

The order of the reaction is

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

117. Substance 'A' is exposed to $600\ nm, 100\ W$ light source for $6626\ s$, with 50% of the incident light being absorbed. 'A' decomposes according to the reaction $A \rightarrow 2B$. As a result of irradiation, $0.2\ mol$ of B is produced. The quantum yield of the reaction is closest to

(a) 6×10^6 (b) 6×10^{-4} (c) 6×10^{-2} (d) 6

118. A gas is known to satisfy Langmuir isotherm when adsorbed on a certain metal surface. If the fractional coverage of the gas 0.5 when the gas pressure is 1.0 Pa, the fractional coverage at 3.0 Pa would be closest to

(a) 0.67 (b) 0.75 (c) 0.80 (d) 1.0

119. Iron belongs to the bcc lattice. The Miller indices of the second allowed reflection in the powder diffraction pattern of iron would be

(a) (100) (b) (111) (c) (200) (d) (210)

120. The degree of polymerization at $t = 10$ h of a polymer formed by a stepwise process with polymerization rate constant of $3 \times 10^{-2}\ M^{-1}\ s^{-1}$ and an initial monomer concentration of 50 mM is

(a) 55 (b) 65 (c) 550 (d) 505

Answer Key

PART - B

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

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

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

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

PART - C

Q.No	Ans

Q.No	Ans

Q.No	Ans

Q.No	Ans

61.	d
62.	a
63.	c
64.	c
65.	c
66.	c
67.	a
68.	b
69.	a
70.	c
71.	a
72.	c
73.	c
74.	a
75.	d

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

91.	a
92.	b
93.	c
94.	d
95.	a
96.	b
97.	a
98.	d
99.	c
100.	d
101.	a
102.	b
103.	d
104.	d
105.	d

106.	b
107.	a
108.	b
109.	b
110.	b
111.	c
112.	b
113.	c
114.	d
115.	b
116.	c
117.	c
118.	b
119.	c
120.	a