A-54

ENTRANCE EXAMINATION – 2021

Ph. D. Chemistry – 2021

TIME: 2 HOURS **MAXIMUM MARKS : 70**

HALL TICKET NUMBER:

INSTRUCTIONS

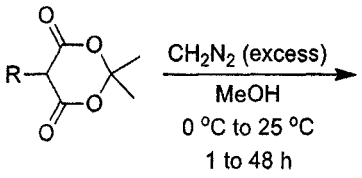
1. Write your **HALL TICKET NUMBER** in the space provided above and also on the **OMR** ANSWER SHEET given to you.
2. Make sure that pages numbered from **1 - 25** are present (excluding 5 pages assigned for rough work).
3. There are eighty (80) multiple-choice questions in this paper (**20 in Part-A** and **60 in Part-B**). You are required to answer **all questions of Part-A** and a **maximum of 20 questions of Part-B**. If more than the required number of questions are answered in Part-B, **only the first 20 questions** will be evaluated.
4. Each question in Part-A and Part-B carries **1.75 marks**
5. There is **no negative marking** for both Part – A and Part – B.
6. Answers are to be marked on the OMR answer sheet following the instructions provided on it.
7. Handover the OMR answer sheet to the invigilator at the end of the examination.
8. In case of a tie, the marks obtained in the first 20 questions (**Part-A**) will be used to determine the order of merit.
9. No additional sheets will be provided. Rough work can be done in the space provided at the end of the booklet.
10. Calculators are allowed. Cell phones are not allowed.
11. Useful constants are provided just above Part-A in the question paper.
12. OMR without hall ticket number will not be evaluated and University shall not be held responsible.

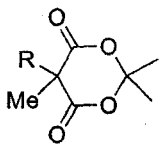
Useful Constants:

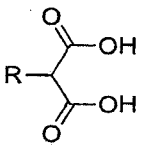
Rydberg constant = 109737 cm^{-1}; Faraday constant = 96500 C; Planck constant = 6.625×10^{-34} J s; Speed of light = 2.998×10^{8} ms^{-1}; Boltzmann constant = 1.380×10^{-23} J K^{-1}; Gas constant = 8.314 J K^{-1} mol^{-1} = 0.082 L-atm K^{-1} mol^{-1} = 1.987 cal K^{-1} mol^{-1}; Mass of electron = 9.109×10^{-31} kg; Mass of proton = 1.672×10^{-27} kg; Charge of electron = 1.6×10^{-19} C; 1 bar = 10^{5} N m^{-2}; RT/F (at 298.15 K) = 0.0257 V; Avogadro number = 6.022×10^{23}; 1 nm = 1239.84 eV

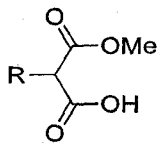
PART A

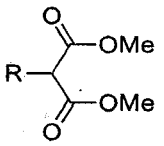
1. The product formed in the following reaction is:



[A] 

[B] 

[C] 

[D] 

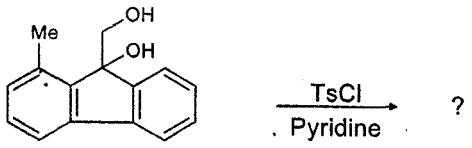
2. Merrifield resin was first used for the synthesis of:

[A] Proteins [B] Deoxyribonucleic acid [C] Ribonucleic acid [D] Carbohydrates

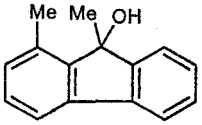
3. The key intermediate involved in the classical synthesis of Vitamin A is:

[A] β-ionone
[B] ergocalciferol
[C] L-sorbose
[D] 2-methyl-1,4-benzoquinone

4. The major product obtained in the following transformation is:



[A]



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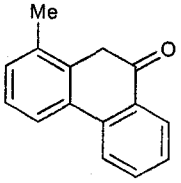

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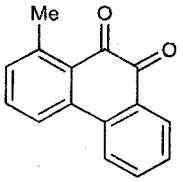

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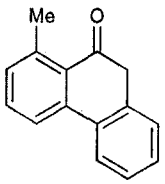
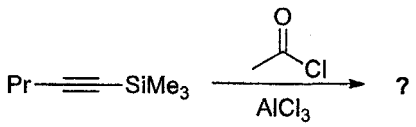


5. The product formed in the following reaction is:



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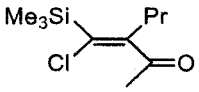

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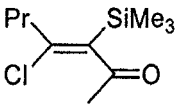
[C]



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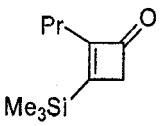


6. Among the following, the pair of Bravais lattices that are identical is:

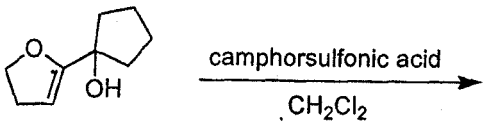
[A] face-centered and body-centered cubic

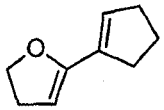
[B] face-centered and body-centered tetragonal

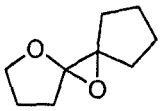
[C] body-centered and base-centered orthorhombic

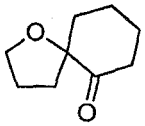
[D] primitive and base-centered monoclinic

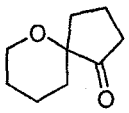
7. The major product formed in the following reaction is:



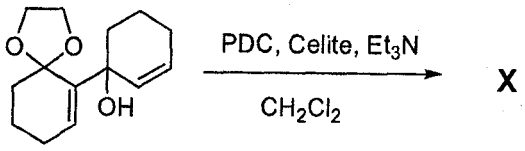
[A] 

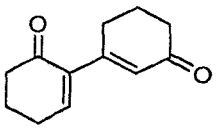
[B] 

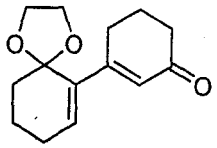
[C] 

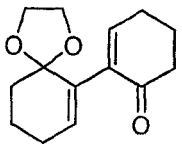
[D] 

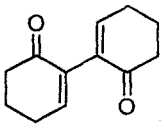
8. The major product **X** formed in the following reaction is:



[A] 

[B] 

[C] 

[D] 

9. With increasing temperature, Curie and Pauli paramagnetic susceptibilities:

[A] both remain constant

[B] decrease and increase, respectively

[C] both decrease

[D] decrease and remain constant, respectively

10. The value of the commutator $[x/2, p_x]$ is:

[A] $i\hbar/2$ [B] $-i\hbar$

[C] $2i\hbar$ [D] $\hbar$

11. The ionic mobilities of CH_3COO^-, Cs^+, H^+, and Li^+ ions in aqueous solution follows the order:

[A] $CH_3COO^- > Cs^+ > H^+ > Li^+$

[B] $Cs^+ > H^+ > Li^+ > CH_3COO^-$

[C] $H^+ > Li^+ > Cs^+ > CH_3COO^-$

[D] $H^+ > Cs^+ > Li^+ > CH_3COO^-$

12. The vibrational frequency of a diatomic molecule A-B is ν. If another diatomic molecule C-D has the same force constant and the masses of C and D are respectively twice that of A and B, the vibrational frequency of C-D is:

[A] 2ν [B] $\sqrt{2}\nu$

[C] ν/2 [D] $\nu/\sqrt{2}$

13. The frequency of transition between the nuclear spin levels of a ^{13}C nucleus in a magnetic field of 14.4 T is (magnetogyric ratio = 6.73×10^7 rad T^{-1} s^{-1}):

[A] 186 MHz [B] 176 MHz

[C] 168 MHz [D] 154 MHz

14. The total number of degenerate eigenstates possible for the ground state of a particle-in-a-3D cubic box of length a is:

[A] 1 [B] 3

[C] 2 [D] 4

15. The differential scanning calorimetry scan of a semi-crystalline polymer is expected to display:

[A] Only glass transition temperature
[B] Only melting temperature
[C] Both glass transition and crystalline melting temperatures.
[D] Either glass transition or crystalline melting temperature

16. The compound with *nonzero* dipole moment among PF_5, NF_3, BF_3 and *trans*-$PtCl_2(NH_3)_2$ is:

[A] PF_5
[B] NF_3
[C] BF_3
[D] *trans*-$PtCl_2(NH_3)_2$

17. In tetragonally compressed low-spin $[CuF_6]^{2-}$, the unpaired electron resides in the orbital:

[A] d_{z^2} [B] $d_{x^2-y^2}$ [C] d_{xz} [D] d_{xy}

18. In the cubic zinc blende structure of ZnS,

[A] each S^{2-} ion is octahedrally surrounded by six Zn^{2+} ions
[B] each Zn^{2+} ion is octahedrally surrounded by six S^{2-} ions
[C] each Zn^{2+} ion is tetrahedrally surrounded by four S^{2-} ions and each S^{2-} ion is octahedrally surrounded by six Zn^{2+} ions
[D] each Zn^{2+} ion is tetrahedrally surrounded by four S^{2-} ions and each S^{2-} ion is tedrahedrally surrounded by four Zn^{2+} ions

19. The diffraction method best suitable to investigate *agostic interaction* in organometallic complexes is:

[A] Single crystal X-ray Diffraction
[B] Powder X-ray Diffraction
[C] Neutron Diffraction
[D] Electron Diffraction

20. The geometries around Au and I atoms in Au_2Cl_6 and I_2Cl_6, are respectively,

[A] planar and planar
[B] planar and nonplanar
[C] nonplanar and planar
[D] nonplanar and nonplanar

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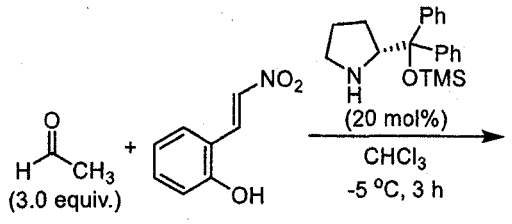
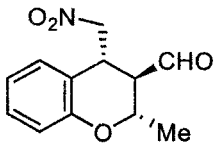
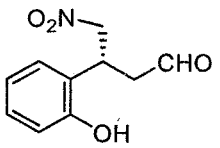
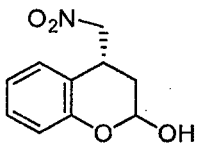
PART B

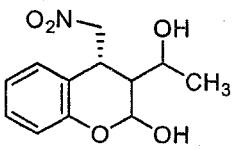
21. The major product formed in the following reaction is:



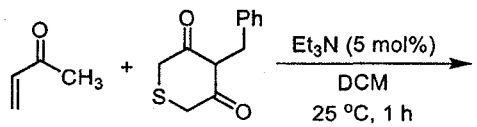
[A] 

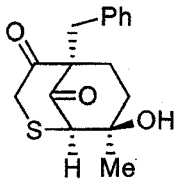
[B] 

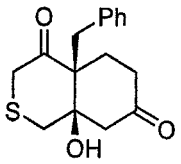
[C] 

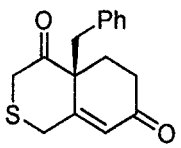
[D] 

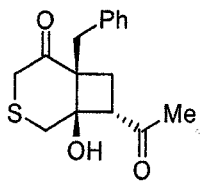
22. The suitable major product of the following reaction is:



[A] 

[B] 

[C] 

[D] 

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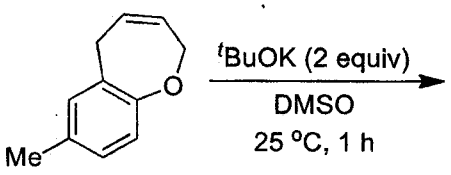
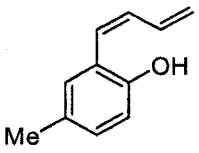
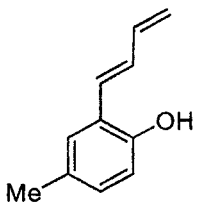
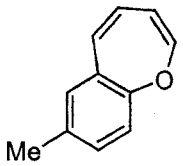
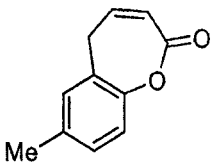
23. The suitable major product of the following reaction is:



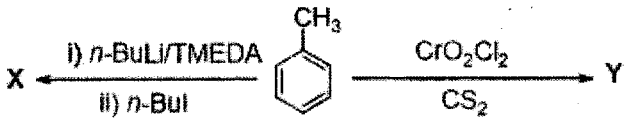
[A] 

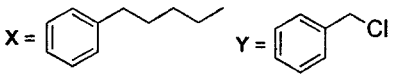
[B] 

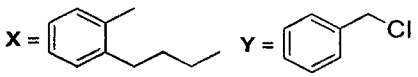
[C] 

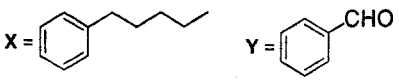
[D] 

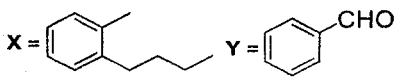
24. The products **X** and **Y** formed in the following reactions are:



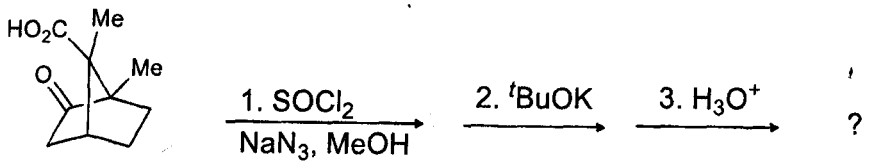
[A] 

[B] 

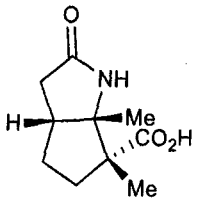
[C] 

[D] 

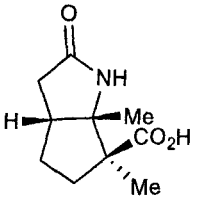
25. The product obtained in the following transformation is:



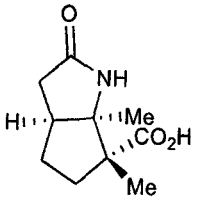
[A]



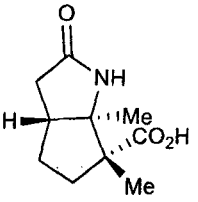
[B]



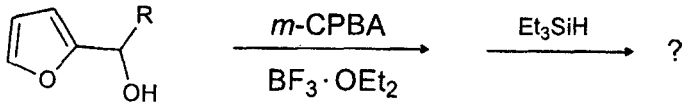
[C]



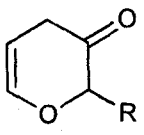
[D]



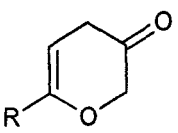
26. The major product obtained in the following transformation is:



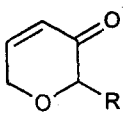
[A]



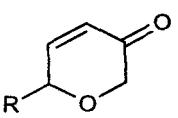
[B]



[C]

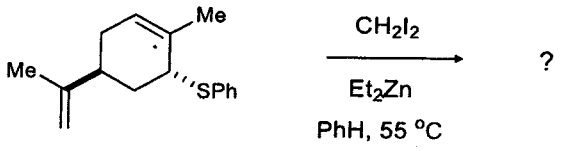


[D]

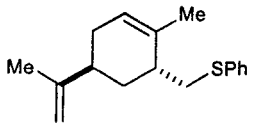


A-54

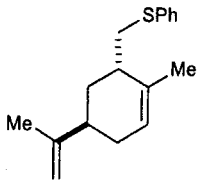
27. The major product obtained in the following transformation is:



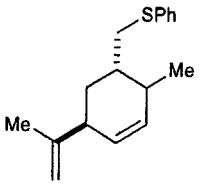
[A]



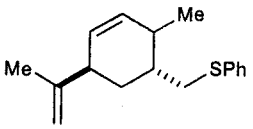
[B]



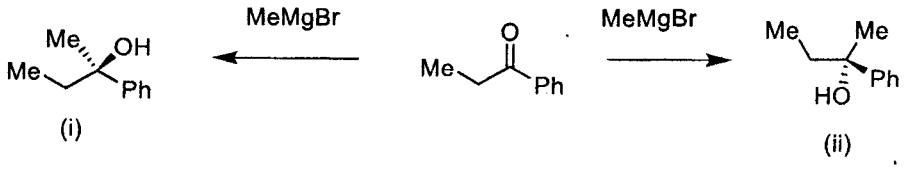
[C]



[D]

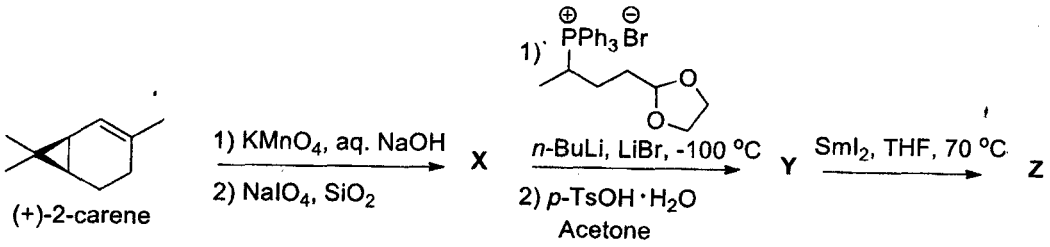


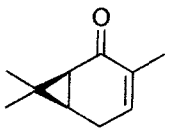
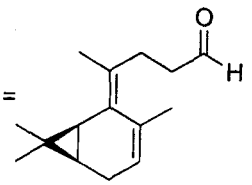
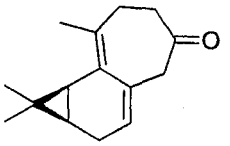
28. The modes of addition followed during the formation of products (i) and (ii) respectively, are:

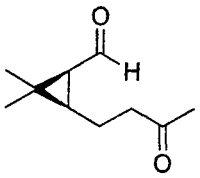
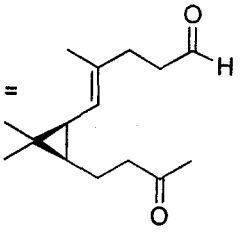
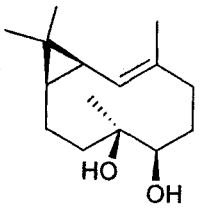


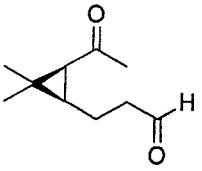
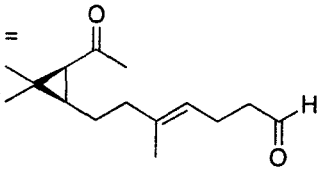
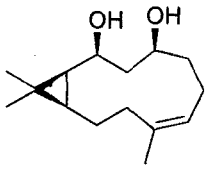
[A] *si*-, *re*-additions
[B] *re*-, *si*-additions
[C] *si*-, *si*- additions
[D] *re*-, *re*- additions

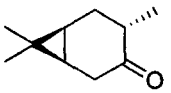
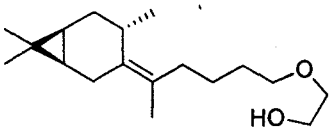
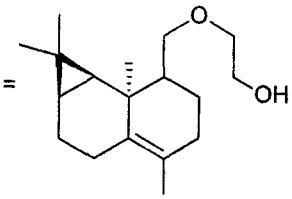
29. The products **X**, **Y** and **Z** obtained in the following reactions are:



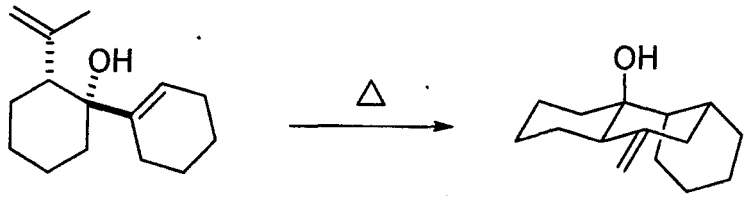
[A] **X** =  **Y** =  **Z** = 

[B] **X** =  **Y** =  **Z** = 

[C] **X** =  **Y** =  **Z** = 

[D] **X** =  **Y** =  **Z** = 

30. The following transformation involves:



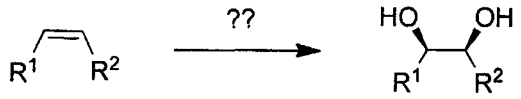
[A] Trans-annular ene reaction followed by oxy-Cope rearrangement

[B] Oxy-Cope rearrangement followed by trans-annular ene reaction

[C] Oxy-Cope rearrangement followed by retro-ene reaction

[D] Retro-ene reaction followed by oxy-Cope rearrangement

31. The suitable reagents and the name of the following reaction are:



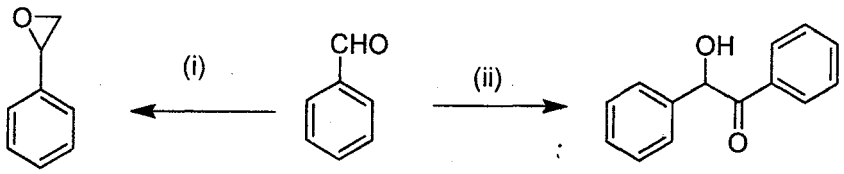
[A] (i) OsO_4; Upjohn dihydroxylation

[B] (i) AgOAc, I_2, H_2O (ii) KOH; Prevost dihydroxylation

[C] (i) AgOAc, I_2, H_2O (ii) KOH; Woodward dihydroxylation

[D] (i) $PhCO_2Ag$, I_2 (ii) KOH; Prevost dihydroxylation

32. Identify the suitable reagents for the following transformation:



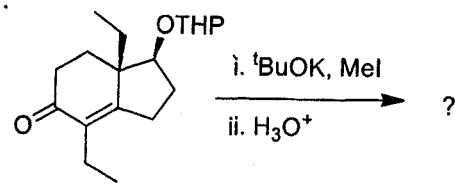
[A] (i) KCN; (ii) $Me_3S^+I^-$, NaH

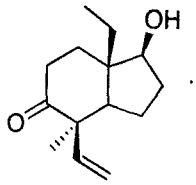
[B] (i) NaOH; CH_2O; (ii) Thiamine hydrochloride

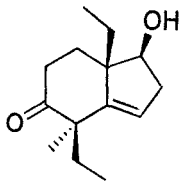
[C] (i) *n*-BuLi, CH_2O; (ii) PCC

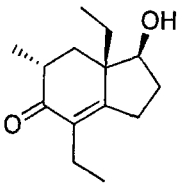
[D] (i) $Me_3S^+I^-$, NaH; (ii) KCN

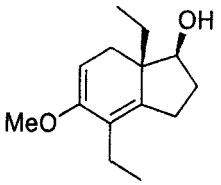
33. The major product formed in the following reaction is:



[A] 

[B] 

[C] 

[D] 

34. The rate of cyclization of given hydroxyalkyl chlorides [$Cl(CH_2)_nOH$], follows the order:

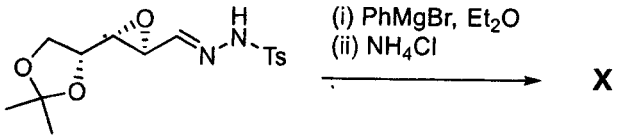
[A] $Cl(CH_2)_3OH > Cl(CH_2)_4OH > Cl(CH_2)_5OH$

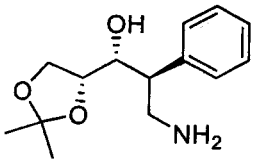
[B] $Cl(CH_2)_3OH > Cl(CH_2)_5OH > Cl(CH_2)_4OH$

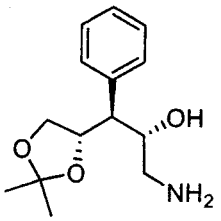
[C] $Cl(CH_2)_4OH > Cl(CH_2)_5OH > Cl(CH_2)_3OH$

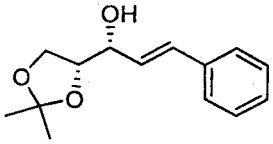
[D] $Cl(CH_2)_4OH > Cl(CH_2)_3OH > Cl(CH_2)_5OH$

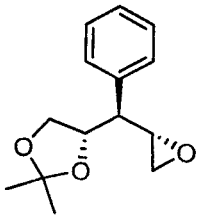
35. The major product **X** formed in the following reaction is:



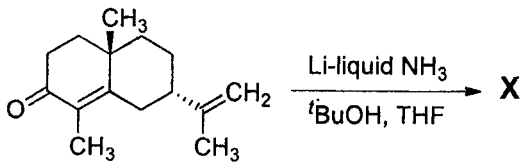
[A] 

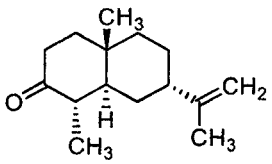
[B] 

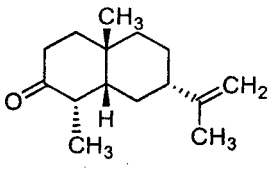
[C] 

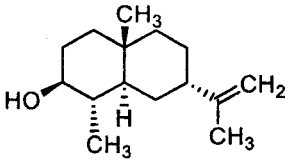
[D] 

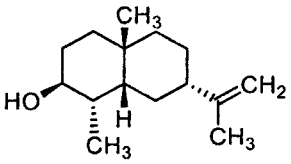
36. The major product **X** formed in the following reaction sequence is:



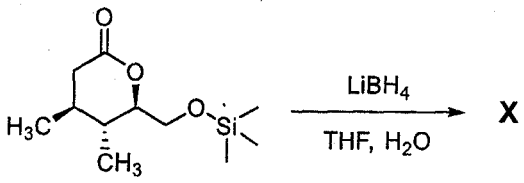
[A] 

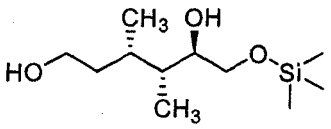
[B] 

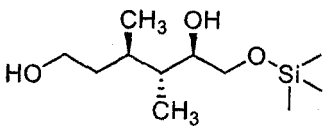
[C] 

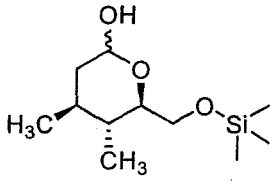
[D] 

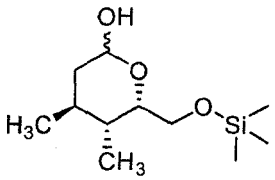
37. The major product **X** formed in the following reaction is:



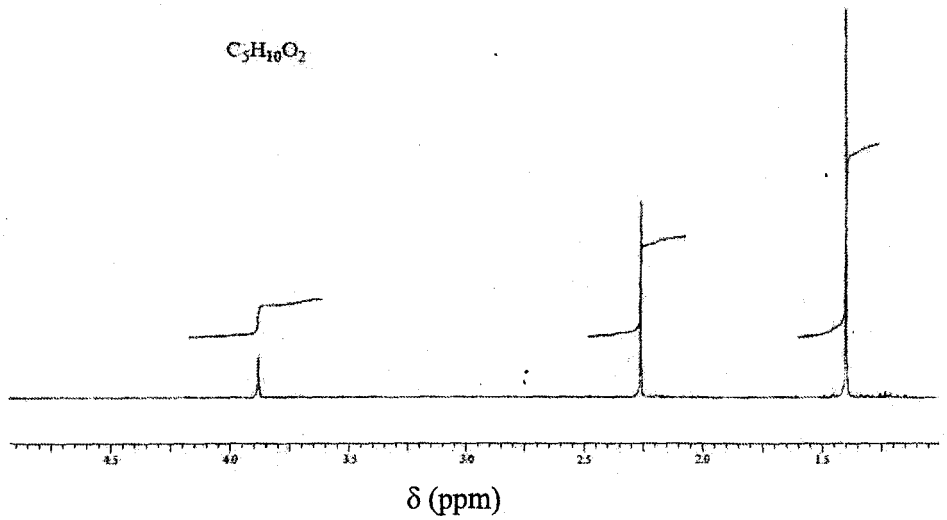
[A] 

[B] 

[C] 

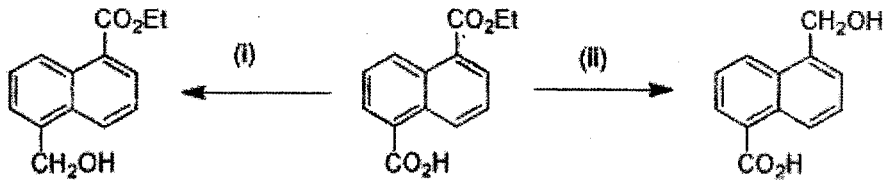
[D] 

38. Compound **X** ($C_5H_{10}O_2$) gives the following ^{1}H-NMR spectrum. The peaks at 1.40, 2.25 and 3.90 ppm are with an intensity ratio of nearly 6:3:1. Compound **X** is:



[A] 1-hydroxy-3-methyl-butan-2-one
[B] 3-hydroxy-3-methyl-butan-2-one
[C] 1-hydroxy-pentane-3-one
[D] 2-hydroxy-pentan-3-one

39. The suitable reagents (i) and (ii) for the following transformations are:



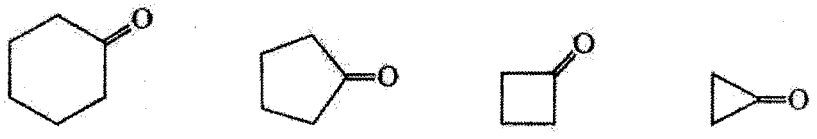
[A] (i) $LiBH_4$; (ii) $BH_3.SMe_2$

[B] (i) $BH_3.THF$; (ii) $LiBH_4$

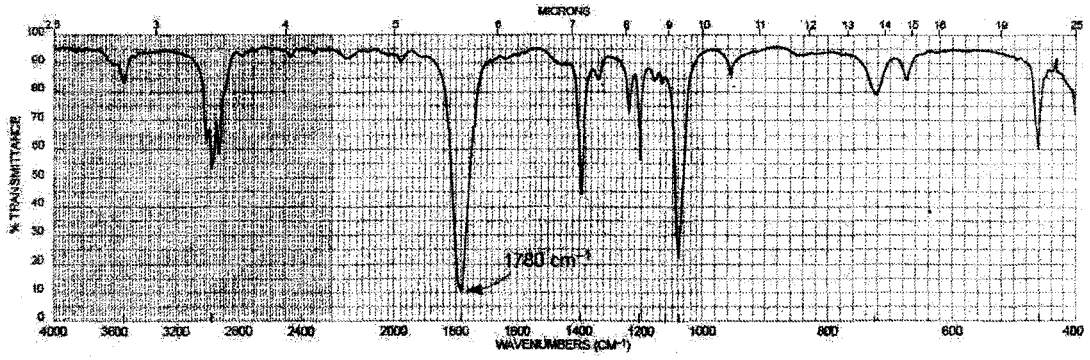
[C] (i) $BH_3.SMe_2$; (ii) $LiAlH_4$

[D] (i) $NaCNBH_3$; (ii) $LiBH_4$

40. The IR spectrum shown below is exhibited by one of the following ketones.



W **X** **Y** **Z**



[A] **W**

[B] **Y**

[C] **X**

[D] **Z**

41. NaCl has interpenetrating fcc lattices of Na^+ and Cl^- with Na^+ in the octahedral site of Cl^- and *vice versa*. The distance between the closest Na^+ and Cl^- is 2.82 Å. The distance between the closest Na^+ ions (in Å) is:

[A] 5.64 [B] 4.88

[C] 3.99 [D] 2.82

42. The coefficient of thermal expansion is defined as, $\alpha = \frac{\Delta V}{V_o \Delta T}$, where V_o is the original volume, and ΔV and ΔT are the change in volume and temperature respectively. The X-ray diffraction peak corresponding to the (1 1 1) plane of a crystal with a primitive cubic lattice shifts from $2\theta = 30°$ to $2\theta = 20°$ when the temperature is increased from 100 to 300 K. The α of the crystal (in K^{-1}) is:

[A] 0.671 [B] 0.250

[C] 0.067 [D] 0.012

43. A transition that occurs in materials, by a mechanism equivalent to the Jahn-Teller distortion in molecules, is:

[A] metal-semiconductor [B] paramagnet-ferromagnet

[C] solid-liquid [D] paraelectric-ferroelectric

44. The spin part of the Heitler-London ground electronic wave function of H_2 is:

[A] $2^{-1/2}\,[\alpha(1)\beta(2) - \alpha(2)\beta(1)]$ [B] $2^{-1/2}\,[\alpha(1)\beta(2) + \alpha(2)\beta(1)]$

[C] $\alpha(1)\,\alpha(2)$ [D] $\beta(1)\,\beta(2)$

45. The longest wavelength absorption peak in the electronic spectrum of butadiene appears at 217 nm. According to Hückel model, the stabilization energy of butadiene owing to a delocalization of π electrons is:

[A] 1.66 eV [B] 0.66 eV

[C] 2.21 eV [D] 4.32 eV

46. If the radius of the first Bohr orbit of H-atom is x, then the de Broglie wavelength of an electron in the third Bohr orbit is:

[A] $3\pi x$ [B] $4\pi x$

[C] $5\pi x$ [D] $6\pi x$

47. The half-life period of a gaseous reaction is 350 s at an initial pressure of 80 kPa at 500 K. When the pressure is reduced by a factor of two, the half-life becomes 175 s at the same temperature. The order of the reaction is:

[A] 3 [B] 2

[C] 0 [D] 1

48. The commutator $i[\hat{H}, \hat{p}]/\hbar$ defines:

[A] Energy [B] Velocity

[C] Force [D] Frequency

49. The rate constant of the gas phase reaction $2NO_2 + F_2 \rightarrow 2NO_2F$ is 3.8×10^6 dm^3 $mole^{-1}$ s^{-1} at 300 K. The order of the reaction is:

[A] 0 [B] 1

[C] 2 [D] 3

50. For a set of two parallel first-order reactions, A $\rightarrow$ P and A $\rightarrow$ Q with rate constants, k_1 and k_2, respectively, the concentration of P at infinite time is:
(A_0 is initial concentration of A)

[A] $k_1[A_0]$ [B] $k_1[A_0]/(k_1+k_2)$

[C] $(k_1/k_2)[A_0]$ [D] $(k_1+k_2)[A_0]$

51. A defect-free crystal has a density of 2.000 g cm^{-3}. If it had 0.1% Frenkel or Schottky defect sites, the density would be respectively:

[A] 1.998, 2.000 [B] 2.000, 1.900

[C] 2.000, 1.998 [D] 1.999, 1.999

52. The collision theory expression for the rate constant of a bimolecular reaction is given below.

$$k = N_0 \left(\frac{8k_BT}{\pi\mu}\right)^{1/2} \pi\, d_{AB}^2 e^{-\frac{E_0}{k_BT}}$$

The activation energy (E_a) of the Arrhenius expression is related to E_0 as:

[A] $E_a = E_0 + RT$ [B] $E_a = E_0 + \frac{1}{2}RT$

[C] $E_a = N_0E_0 + \frac{1}{2}RT$ [D] $E_a = N_0E_0 - \frac{1}{2}RT$

53. The molar absorption coefficient of a solute at 540 nm is 286 L mol^{-1} cm^{-1}. When the light of that wavelength passes through a 6.5 mm cell containing a solution of the solute, 46.5% of the light was absorbed. The concentration of the solution is:

[A] 4.5 mM [B] 3.0 mM

[C] 1.5 mM [D] 7.5 mM

54. The vibrational frequency of oxygen molecule is 1580 cm^{-1}. The vibrational temperature (θ_v) of oxygen molecule (in K) is nearly equal to:

[A] 569 [B] 1138

[C] 2276 [D] 3414

55. The rotational constant of O_2 is 1.45 cm^{-1}. At 300 K, the value of the rotational partition function is nearly equal to:

[A] 36 [B] 72

[C] 144 [D] 288

56. In a Daniel cell, $E^0 = 1.099$ V and the ratio of concentration of $CuSO_4$ and $ZnSO_4$ is 2:1. The cell potential at 298 K is [assume that activities of the ionic species are equivalent to their molalities]:

[A] 1.08 V [B] 1.11 V

[C] 1.12 V [D] 1.09 V

57. Based on the great orthogonality theorem, the missing characters in the irreducible representations Γ_2 and Γ_3 are:

	E	$2C_3$	$3\sigma_v$
Γ_1	1	1	1
Γ_2			
Γ_3			

[A] $\Gamma_2 = 1,1,-1$ and $\Gamma_3 = -1,1,-1$ [B] $\Gamma_2 = 1,1,-1$ and $\Gamma_3 = 2,-1,0$

[C] $\Gamma_2 = 1,-1,-1$ and $\Gamma_3 = 1,1,-1$ [D] $\Gamma_2 = 1,2,-1$ and $\Gamma_3 = 2,0,0$

58. Calculate the potential (emf) of the cell: Cd | Cd^{2+} (0.10 M) || H^+ (0.20 M) | Pt, H_2 (0.5 atm) at 298 K [E° for Cd^{2+} / Cd = – 0.403 V].

[A] 0.500 V [B] 0.600 V

[C] 0.400 V [D] 0.300 V

59. The characters per un-shifted point under $\hat{C}_4$ and $\hat{S}_4$ symmetry operations are respectively:

[A] $-1,-1$ [B] 0,0

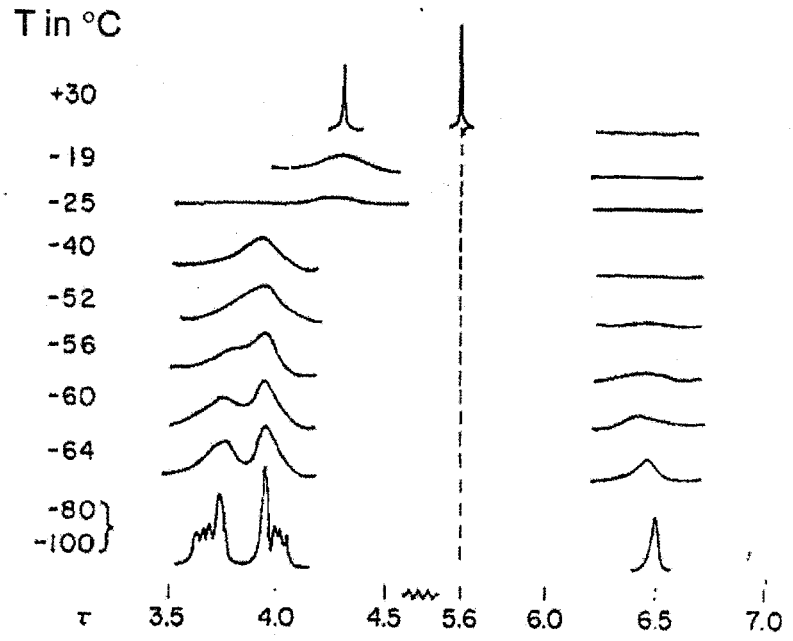
[C] $1,-1$ [D] $-1,1$

60. Butadiene has an absorption at 4.54×10^4 cm^{-1} for a transition from $n = 2$ state to $n = 3$ state. Assuming particle in a box model, the approximate total length of the molecule is:

[A] 5.78 Å [B] 4.78 Å

[C] 6.78 Å [D] 7.78 Å

61. The proton NMR spectra of $(C_5H_5)_2Fe(CO)_2$ in CS_2 at various temperatures are given below. The resonance peak at $\delta = 4.4$ ppm corresponds to:



[A] η^1-(C_5H_5)

[B] η^3-(C_5H_5)

[C] η^5-(C_5H_5)

[D] η^1-(C_5H_5) and η^5-(C_5H_5)

62. The oxidation states of P in $H_4P_2O_5$, $H_4P_2O_6$ and $H_4P_2O_7$ are, respectively:

[A] +3, +5, and +4

[B] +5, +3, and +4

[C] +5, +4, and +3

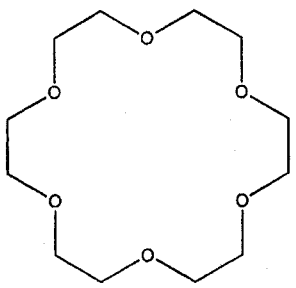
[D] +3, +4, and +5

63. Match the following silicates:

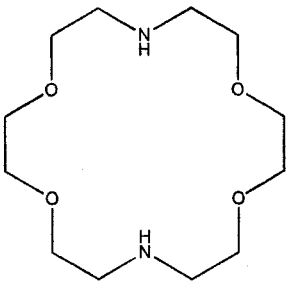
A	$[Si_4O_{11}]_n^{6n-}$	**P**	Layered structure
B	$[SiO_3]_n^{2n-}$	**Q**	Double chain
C	$[Si_2O_5]_n^{2n-}$	**R**	Single chain

[A] **A=R; B=P; C=Q**
[B] **A=Q; B=R; C=P**
[C] **A=P; B=S; C=R**
[D] **A=Q; B=P; C=R**

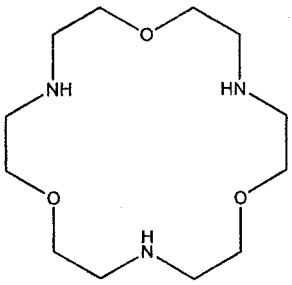
64. Among the macrocycles **I, II** and **III**, the one with greatest affinity for K^+ ion, and the corresponding coordination geometry around the metal ion, are respectively,



I



II



III

[A] **I** and octahedral
[B] **I** and planar hexagonal
[C] **II** and planar hexagonal
[D] **III** and octahedral

65. The σ-bond between two Re atoms in $[Re_2Cl_8]^{2-}$ will have contribution from the following orbital(s):

[A] d_{z^2}
[B] d_{xy}, d_{yz} and $p\pi$
[C] d_{xz}, d_{yz} and p_z
[D] d_{xy}

66. The oxidation states of iron in *hemoglobin*, *myoglobin*, *transferrin* and *ferritin* in their resting states are, respectively

[A] +3, +3, +2 and +2. [B] +2, +3, +2 and +3.

[C] +3, +2, +2 and +3. [D] +2, +2, +3 and +3.

67. A vital role $CuCl_2$ in the Wacker Process is:

[A] avoiding Pd metal precipitation
[B] reacting with hydrochloric acid
[C] reducing Pd salt
[D] splitting water

68. The coordination geometries around the metal ion in *rubredoxin*, *cytochromes* and *plastocyanin* are:

[A] tetrahedral, octahedral and flattened-tetrahedral, respectively
[B] tetrahedral, octahedral and tetrahedral, respectively
[C] tetrahedral, square planar and pseudo-tetrahedral, respectively
[D] square planar, tetrahedral and pseudo-octahedral, respectively

69. 0.2856 g of sodium oxalate (MW = 134) is dissolved in water followed by the addition of H_2SO_4. This solution is then titrated at 70 °C, requiring 45.12 mL of a $KMnO_4$ solution. The end point is overrun and back titration is carried out with 1.74 mL of 0.0516 (M) oxalic acid solution. The molarity of $KMnO_4$ solution is:

[A] 0.1922 M [B] 0.5160 M

[C] 0.0197 M [D] 0.5000 M

70. The Russell-Saunders ground term for Cu^{3+} is:

[A] $^2D_{3/2}$ [B] $^2D_{5/2}$ [C] $^3F_2$ [D] $^3F_4$

71. The octahedral site stabilization energy (OSSE) for Co^{2+} is:

[A] $-1.33\ Dq_o$ [B] $-2.67\ Dq_o$

[C] $-5.33\ Dq_o$ [D] $-8.44\ Dq_o$

72. The number of geometrical isomers for $[Co(glycinate)_2(NH_3)Cl]^+$ is '**X**' and among these geometrical isomers '**Y**' are optically active. The values of '**X**' and '**Y**', respectively are:

[A] 6 and 4 [B] 7 and 5 [C] 6 and 5 [D] 5 and 4

73. Using HSAB concepts, the reactions predicted to have an equilibrium constant greater than 1 are:

(i) $SO_2 + (Ph)_3P(HOCMe_3) \rightleftharpoons (Ph)_3PSO_2 + HOCMe_3$

(ii) $R_3P{\cdot}BBr_3 + R_3N{\cdot}BF_3 \rightleftharpoons R_3P{\cdot}BF_3 + R_3N{\cdot}BBr_3$

(iii) $CH_3HgI + HCl \rightleftharpoons CH_3HgCl + HI$

(iv) $LiI + CsF \rightleftharpoons LiF + CsI$

[A] (i) and (ii) [B] (ii) and (iii) [C] (iii) and (iv) [D] (i) and (iv)

74. The total number of theoretically predicted electronic transitions expected on lowering the symmetry of $[Cr(en)_3]^{3+}$ to *trans*-$[Cr(en)_2F_2]^+$, {en = ethylenediamine} is:

[A] 3 [B] 5 [C] 6 [D] 4

75. As per total valence electron counting the zintl ion $[TlSn_8]^{3-}$ belong to:

[A] *Closo* [B] *Nido* [C] *Arachno* [D] *Hypo*

76. The correct order of relative rates for water exchange reactions in $[Mn(OH_2)_6]^{2+}$, $[Cr(OH_2)_6]^{3+}$, and $[Fe(OH_2)_6]^{3+}$ is:

[A] $[Mn(OH_2)_6]^{2+} > [Cr(OH_2)_6]^{3+} > [Fe(OH_2)_6]^{3+}$

[B] $[Mn(OH_2)_6]^{2+} > [Fe(OH_2)_6]^{3+} > [Cr(OH_2)_6]^{3+}$

[C] $[Fe(OH_2)_6]^{3+} > [Mn(OH_2)_6]^{2+} > [Cr(OH_2)_6]^{3+}$

[D] $[Fe(OH_2)_6]^{3+} > [Cr(OH_2)_6]^{3+} > [Mn(OH_2)_6]^{2+}$

77. For the following reaction, the first step involves the breaking of a Co-O carbonate chelate bond, which is followed by protonation of the pendant carbonate-O atom. If the reaction is carried out in $H_2{}^{18}O$, the product **I** will have:

$$[Co(NH_3)_4(CO_3)]^+ \xrightarrow{[H_3O]^+,\ H_2O} \underset{\textbf{(I)}}{[Co(NH_3)_4(H_2O)_2]^{3+}} + CO_2$$

[A] two $H_2{}^{18}O$
[B] one $H_2{}^{18}O$ and one $H_2{}^{16}O$
[C] two $H_2{}^{16}O$
[D] $H_2{}^{18}O$ and $H_2{}^{16}O$ in the ratio 2:1

78. The expected number of fluorine environments in IF_5^{2-} and IF_5 are:

[A] one and two, respectively
[B] two and two, respectively
[C] two and one, respectively
[D] one each

79. In inner sphere electron transfer, the sequence (order) of steps involved is:

[A] electron transfer, bridge formation and bridge cleavage
[B] electron transfer, bridge cleavage and bridge formation
[C] bridge formation, electron transfer and bridge cleavage
[D] bridge formation, bridge cleavage and electron transfer

80. The correct order of nucleophilic substitution reaction rates for square planar complexes of Ni(II), Pd(II) and Pt(II) is:

[A] Ni(II) > Pd(II) > Pt(II)
[B] Ni(II) > Pt(II) >Pd(II)
[C] Pd(II) > Ni(II) > Pt(II)
[D] Pt(II) > Pd(II) > Ni(II)

UNIVERSITY OF HYDERBAD
ENTRANCE EXAMINATION – 2021

School/Department/Centre: School of Chemistry
Course/Subject: Ph.D. Chemistry

Q. No.	Answer	Q. No.	Answer	Q. No.	Answer	Q. No.	Answer
1	D	26	C	51	C	76	B
2	A	27	B	52	C	77	B
3	A	28	A	53	C	78	A
4	B	29	B	54	C	79	C
5	B	30	B	55	B	80	A
6	B	31	C	56	B		
7	C	32	D	57	B		
8	B	33	B	58	C		
9	D	34	C	59	C		
10	A	35	C	60	A		
11	D	36	C	61	C		
12	D	37	A	62	D		
13	D	38	B	63	B		
14	A	39	B	64	A		
15	C	40	B	65	A		
16	B	41	C	66	D		
17	B	42	D	67	A		
18	D	43	A	68	A		
19	C	44	A	69	C		
20	A	45	C	70	D		
21	A	46	D	71	B		
22	A	47	C	72	C		
23	A	48	C	73	D		
24	C	49	C	74	C		
25	A	50	B	75	A		

Note/Remarks : For Q. No. 56 the correct answer is B, as given above.

Signature of the Head/Dean
School/Department/Centre