ENTRANCE EXAMINATION – 2019
Ph. D. Chemistry

TIME: 2 HOURS　　　　　　　　　　**MAXIMUM MARKS: 80**

**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 - 23** 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**). Each question in Part-A and Part-B carries **two marks**.

4. Attempt all questions in **Part-A (20 × 2 = 40 marks)**, and any 20 in **Part-B (20 × 2 = 40 marks)**; if more questions are answered in **Part-B**, only the first 20 will be considered for grading. The total will be scaled to **70 marks** for final evaluation.

5. **There is negative marking** for both Part-A and Part-B. **Each wrong answer carries − 0.66 mark.**

6. Answers are to be marked on the OMR answer sheet following the instructions provided on it.

7. Hand over the OMR answer sheet to the invigilator at the end of the examination.

8. In case of a tie, the marks obtained in **Part-A** will be used to determine the order of merit.

8. No additional sheets will be provided. Rough work can be done in the space provided at the end of the booklet.

9. Calculators are allowed. Cell phones are not allowed.

10. Useful constants are provided at the beginning of Part-A in the question paper.

11. 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 m s^{-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 D = 3.336 × 10^{-30} Cm; 1 bar = 10^5 N m^{-2}; RT/F (at 298.15 K) = 0.0257 V; Avogadro number = 6.022 × 10^{23}; Speed of light = 3.0 × 10^8 m s^{-1}

PART A

1. Predict the major product formed in the following reaction:
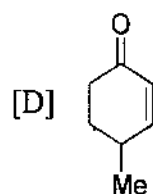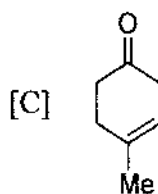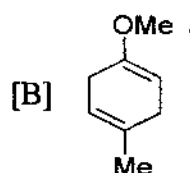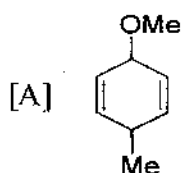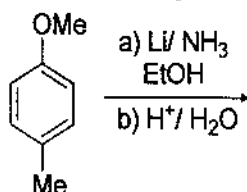
2. Which one of the reagents can perform the following reaction:

R-OH ⟶ R-Cl

[A] CCl$_4$

[B] PPh$_3$/CHCl$_3$

[C] PPh$_3$/CH$_2$Cl$_2$

[D] PPh$_3$/CCl$_4$

3. The Larock indole synthesis involves the reaction of:

[A] benzoquinone and β-aminocrotonic esters.

[B] 2-iodoaniline and a disubstituted alkyne with palladium acetate as a catalyst.

[C] phenylhydrazine and acetone with ZnCl$_2$.

[D] 1-bromo-2-nitrobenzene with vinyl magnesium bromide.

4. Identify a set of alkaloid, steroid and terpene, respectively from the following:

   [A] reserpine, estrone and β-pinene
   [B] cholesterol, reserpine and paracetamol
   [C] reserpine, cholesterol and caprolactam
   [D] cetirizine, camphor and paracetamol

5. The reagents X and Y in the following reactions are:
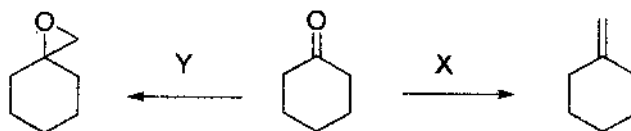
   [A] X = sulfonium ylide and Y = phosphonium ylide
   [B] X and Y = sulfonium ylide
   [C] X = phosphonium ylide and Y = sulfonium ylide
   [D] X and Y = phosphonium ylide

6. The IUPAC name of the following compound is:
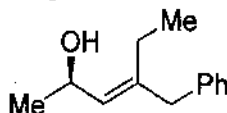
   [A] (2R,3E)-4-ethyl-5-phenylpent-3-en-2-ol
   [B] (2R,3E)-4-benzylhex-3-en-2-ol
   [C] (2S,3Z)-4-benzylhex-3-en-2-ol
   [D] (2R,3Z)-4-ethy-5-phenylpent-3-en-2-ol

7. The torsional angles (φ, ψ) along the peptide backbone in a right handed α-helix in proteins are:

   [A] -60°, -50°
   [B] 180°, 0°
   [C] 180°, 60°
   [D] -140°, 130°

8. The coordination geometry associated with the energy order of the d-orbitals d_{xy}, $d_{yz} > d_{xy}$, $d_{x^2-y^2} > d_{z^2}$ is:

   [A] trigonal planar.
   [B] square-pyramidal.
   [C] trigonal prismatic.
   [D] square-antiprismatic.

9. Two types of bond distances (159.8 pm, 169.8 pm) are observed experimentally for ClF_3. Choose the correct statement from the following:

[A] Both are axial bonds.
[B] The longer one (169.8 pm) is equatorial while the shorter one (159.8 pm) is axial.
[C] The longer one (169.8 pm) is axial while the shorter one (159.8 pm) is equatorial.
[D] Both are equatorial bonds.

10. Two equivalents of a sodium salt of cyclopentadiene react with one equivalent of MCl_2 to give an air-sensitive purple-black metallocene, which subsequently gets oxidized to provide a paramagnetic, yellow colored 18 electron species. The element M is:

[A] Co   [B] Mn
[C] Fe   [D] Cr

11. Ni^{2+} forms coordination complexes, [Ni(HDMG)$_2$] and [Ni(EDTA)]$^{2-}$ quantitatively with two equivalents of dimethylglyoxime (H$_2$DMG) and one equivalent of ethylenediamine tetraacetic acid (EDTA) separately. The estimation of nickel gravimetrically as [Ni(HDMG)$_2$] and titrimetrically as [Ni(EDTA)]$^{2-}$ are possible whereas the gravimetric estimation as [Ni(EDTA)]$^{2-}$ and titrimetric estimation as [Ni(HDMG)$_2$] are not possible because:

[A] [Ni(EDTA)]$^{2-}$ complex is not favorable thermodynamically
[B] H$_2$DMG forms squire-planar complex and EDTA forms octahedral complex with Ni(II)
[C] Low solubility of [Ni(EDTA)]$^{2-}$ complex and rapid reaction of H$_2$DMG with Ni(II)
[D] High solubility of [Ni(EDTA)]$^{2-}$ complex and slow reaction of H$_2$DMG with Ni(II)

12. Beryl [Be$_3$Al$_2$(Si$_6$O$_{18}$)] is a

[A] cyclosilicate   [B] chain silicate
[C] tectosilicate   [D] double chain silicate

13. The correct set of quantum numbers for f-orbitals is:

[A] $n = 4$ or 5, $l = 3$, $m_l = +3, +2, +1, 0, -1, -2, -3$
[B] $n = 3$ or 4, $l = 3$, $m_l = +3, +2, +1, 0, -1, -2, -3$
[C] $n = 5$ or 6, $l = 4$, $m_l = +3, +2, +1, 0, -1, -2, -3$
[D] $n = 4$ or 5, $l = 3$, $m_l = +2, +1, 0, -1, -2$

14. The product of the three two-fold rotation operations around x, y and z axes, $C_2^x C_2^y C_2^z$, is:

[A] E

[B] i

[C] S_2

[D] S_4

15. The π – electron charge in *cis*-butadiene is:

[A]   located more on the terminal atoms

[B]   located less on the terminal atoms

[C]   distributed equally on all atoms

[D]   distributed in an irregular manner on all atoms

16. The correct expression for standard error of mean for a sample with size N and standard deviation σ is

[A] $\dfrac{\sigma}{N}$

[B] $\dfrac{\sigma}{\sqrt{N}}$

[C] σN

[D] σ

17. A crystal is characterized by the translational periodicity of its lattice structure. The lattice can show rotational symmetries of order:

[A]   1, 2 and 3 only

[B]   1, 2, 3, 4 and 6 only

[C]   1, 3, 5 and 7 only

[D]   All below 10

18. Among the following, the operator that is not Hermitian is:

[A] $i\dfrac{d}{dx}$

[B] $\dfrac{d^2}{dx^2}$

[C] $\dfrac{d^3}{dx^3}$

[D] $\dfrac{d^4}{dx^4}$

19. If the Larmor precision frequency of a hypothetical nucleus in a static magnetic field of 15 Tesla (T) is 60 MHz, then the gyromagnetic ratio of the nucleus (in unit of rad s^{-1} T^{-1}) is:
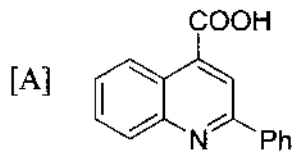
[A] 1.52×10^7

[B] 2.51×10^7

[C] 2.63×10^7

[D] 6.15×10^7

20. A ferromagnetic material above its Curie temperature (100 K) follows Curie-Weiss law. If the temperature is decreased from 300 K to 150 K, the magnetic susceptibility changes by a factor :
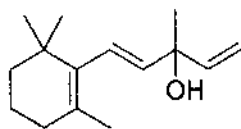
[A] = 0.5

[B] < 2.0

[C] = 2.0

[D] > 2.0

PART B

21. The major product obtained when aniline is heated with benzaldehyde and pyruvic acid is:
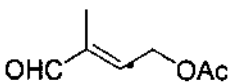
[A]

[B]

[C]

[D]
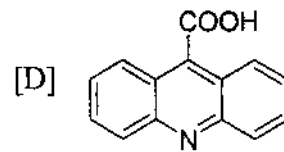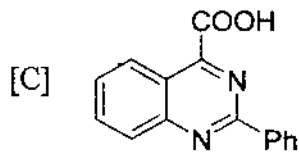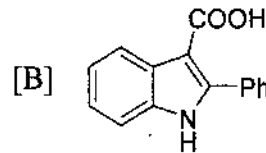
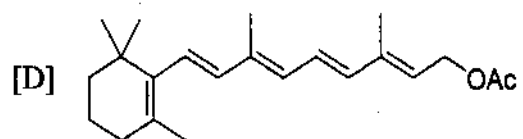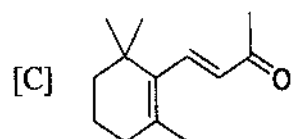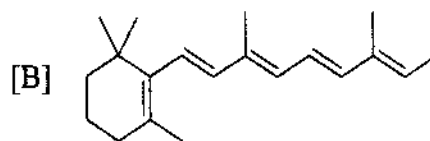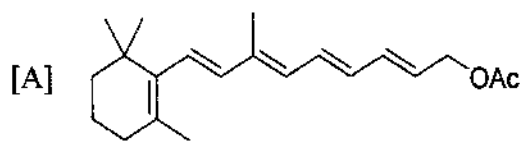22. The major product obtained in the following reaction sequence is:

(i) HBr

(ii) PPh₃

(iii) NaOMe

(iv)

?

[A]

[B]

[C]

[D]

23. The major product obtained in the following reaction is:
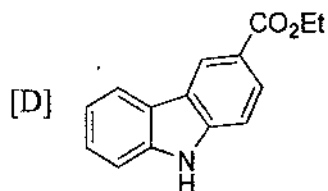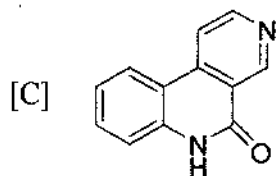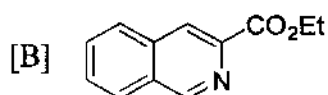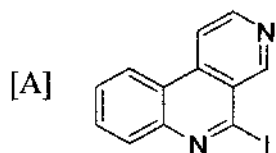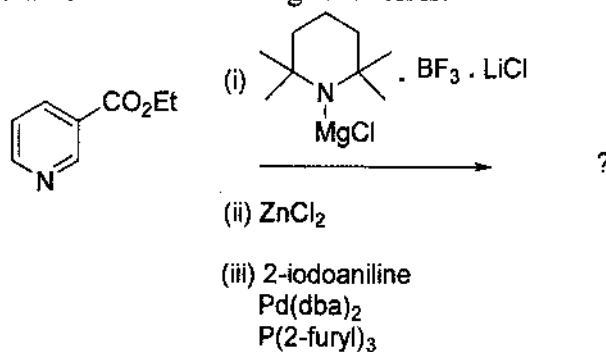
(i) [2,2,6,6-tetramethylpiperidinyl MgCl] . BF_3 . LiCl

(ii) $ZnCl_2$

(iii) 2-iodoaniline
Pd(dba)$_2$
P(2-furyl)$_3$

?

[A]

[B]

[C]

[D]

24. The product formed in the following reaction sequence is:

(i) LDA, PhSeSePh
(ii) LDA, MeI
(iii) H_2O_2

[A]

[B]

[C]

[D]

25. The major product formed in the following transformation is:

Me–C(=O)– cyclobutane with Me, Me and –CHO substituents

$$\xrightarrow[\substack{\text{EtOH, H}_2\text{O} \\ -15\ ^\circ\text{C}}]{\text{NaBH}_4,\ \text{CeCl}_3.7\text{H}_2\text{O}}\quad ?$$
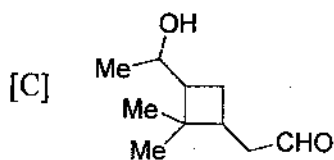
[A]

[B]

[C]

[D]
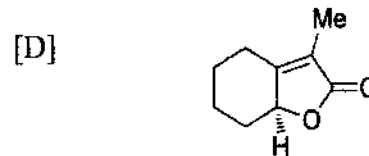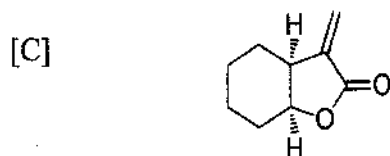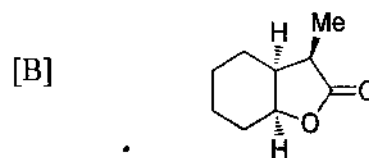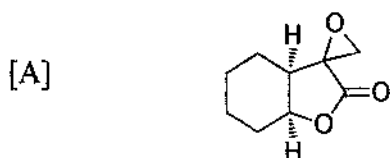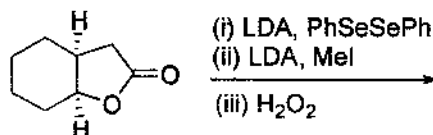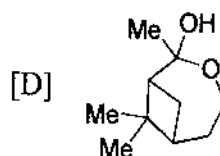
26. The major product(s) formed in the following transformation is (are):

$$\xrightarrow[\text{THF}]{\text{LiAlH}_4}$$

[A]

[B]

[C]

[D]

1 : 1
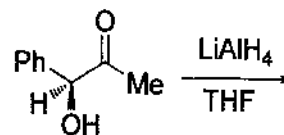
27. The products **X** and **Y** in the following transformations are:

$$\mathbf{Y} \xleftarrow{\text{Et}_2\text{C=O, H}^+} \text{HO}\diagdown\diagup\text{OH (OH)} \xrightarrow{\text{PhCHO, H}^+} \mathbf{X}$$

[A]

X =

Y =

[B]

X =

Y =

[C]

X =

Y =

[D]

X =

Y =

28. The major product formed in the following reaction sequence is:

(i) Zn/AcOH
(ii) PhSeNa
(iii) *m*CPBA, heat

?
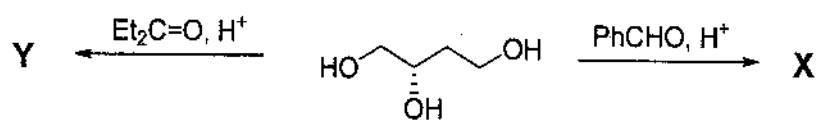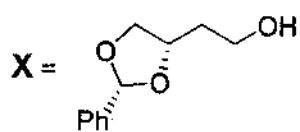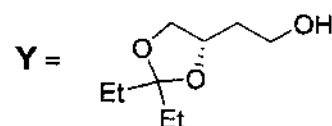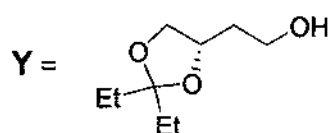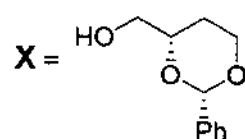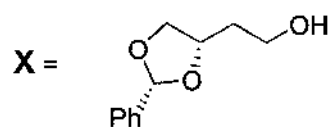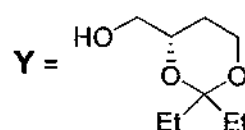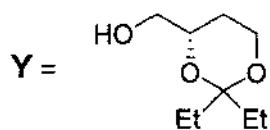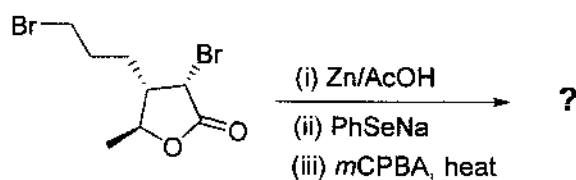
[A]
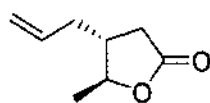
[B]
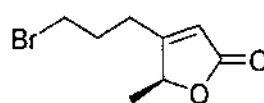
[C]
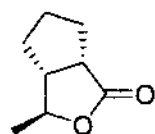
[D]
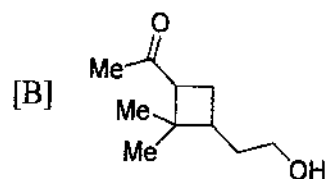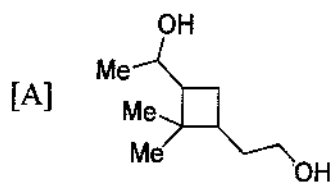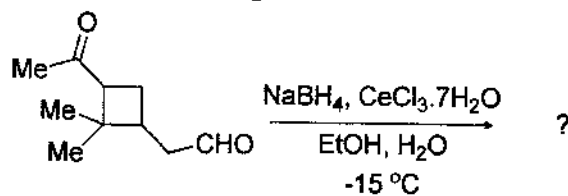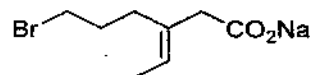
29. The major product formed in the following reaction is:

[A]
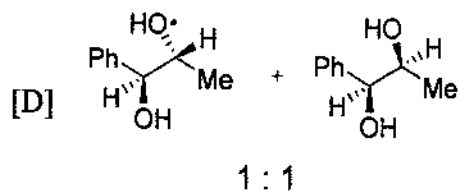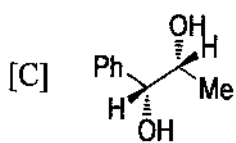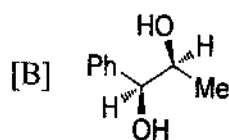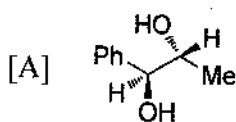
[B]

[C]

[D]
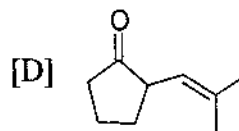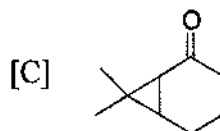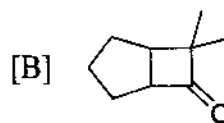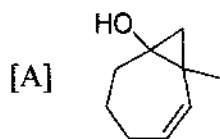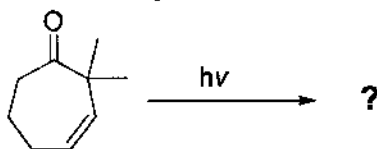
30. The mass spectrum of a compound with molecular formula C_4H_8O is given below. The compound is:
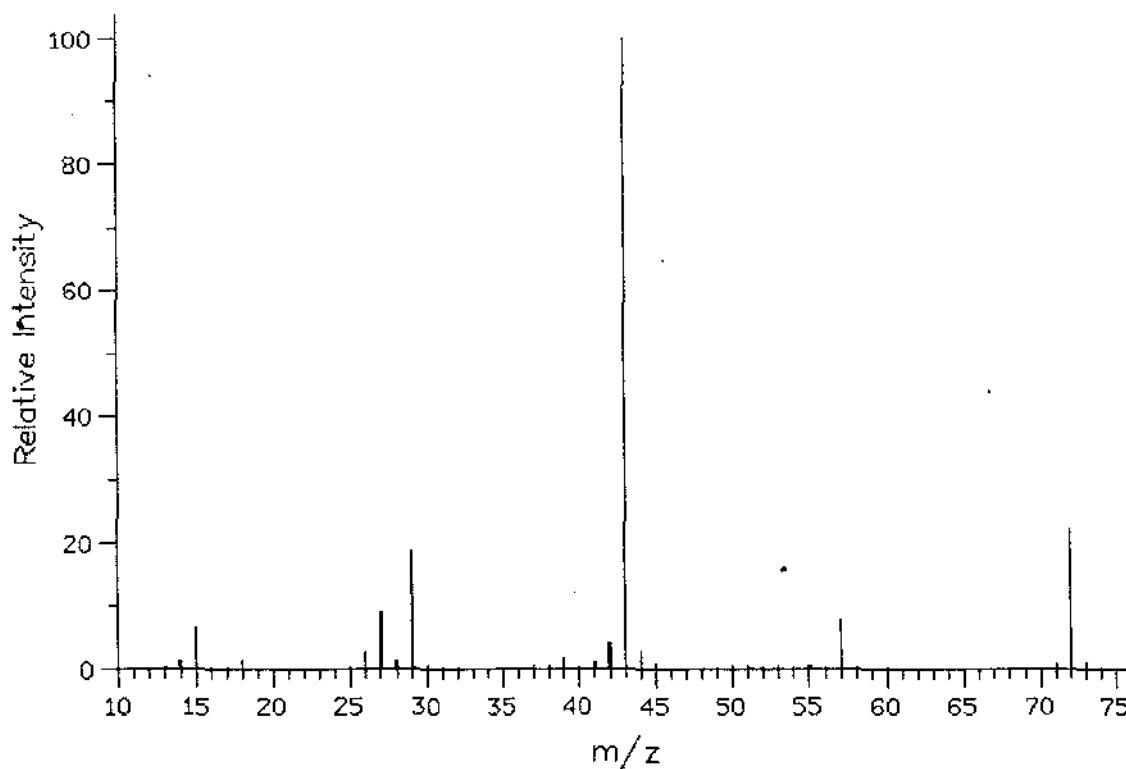
[A] Butyraldehyde

[B] Butan-2-one

[C] Tetrahydrofuran

[D] Cyclobutanol

31. The ^{1}H-NMR spectrum of a compound with molecular formula $C_5H_6O_2$ is given below. Its IR spectrum has an intense peak at ~1735 cm^{-1} and medium intensity sharp peaks at 3270 and 2118 cm^{-1}. The compound is:

$C_5H_6O_2$

| 2.10 | 1.01 | 3.15 |
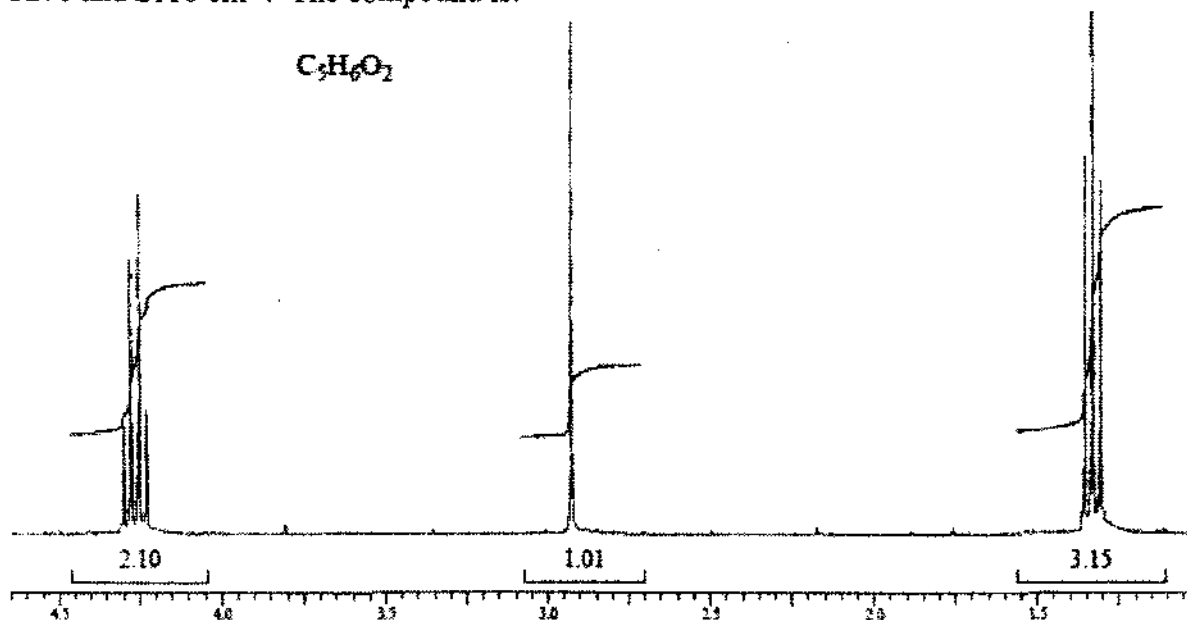
[A] H-C≡C-CH$_2$-(C=O)-O-CH$_3$

[B] CH$_3$-CH$_2$-(C=O)-O-C≡C-H

[C] CH$_3$-(C=O)-O-CH$_2$-C≡C-H

[D] H-C≡C-(C=O)-O-CH$_2$-CH$_3$

32. The most appropriate product for the reaction given below is:

$$\xrightarrow[\substack{CH_2Cl_2 \\ 0\,°C,\ 0.5\ h}]{BF_3 \cdot OEt_2\ (cat.)} \quad ?$$
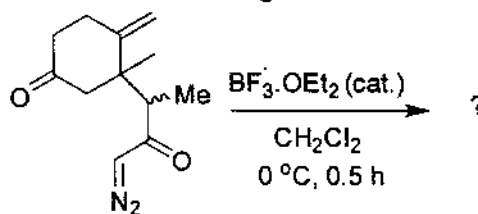
[A]

[B]

[C]

[D]

33. The concept that explains the product distribution of conformational isomers is:

[A] Curtin-Hammett principle

[B] Hammonds postulate

[C] Hammett equation

[D] Microscopic reversibility

34. The product formed in the following reaction is:

[A]

[B]

[C]

[D]
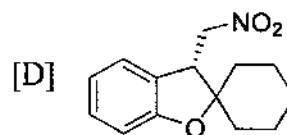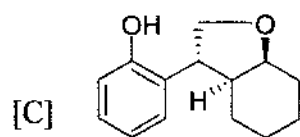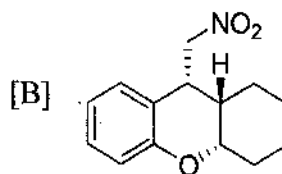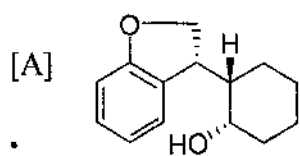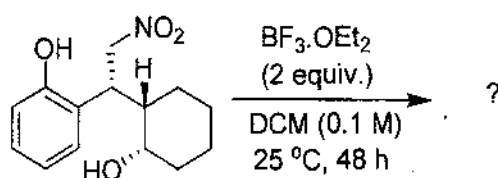
35. Among the following, the Grubb's second generation catalyst for olefin metathesis reaction is:
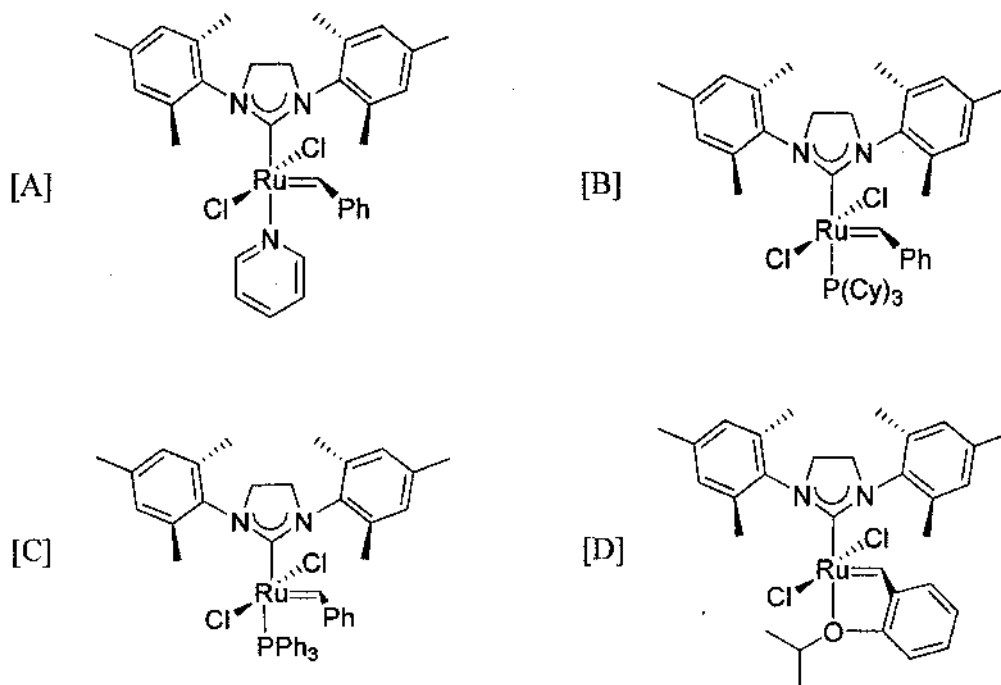
[A]

[B]

[C]

[D]

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

$$\triangleright\!-\!COOEt \xrightarrow[\text{ii. HBr (48\%), Et}_2\text{O}]{\text{i. MeMgBr, THF (2.5 eq)}} ?$$

[A]

[B]

[C]

[D]

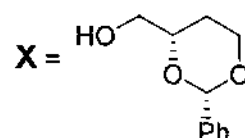37. The products X and Y formed in the following reaction sequence are:

(i) PhMgBr , CuBr
Et₂O/-20 °C

(ii) 2N HCl
(iii) KOH/EtOH reflux

X (Major)

Na/iPrOH,
toluene, reflux

Y (Major)

[A] X= ... Y= ...

[B] X= ... Y= ...

[C] X= ... Y= ...

[D] X= ... Y= ...
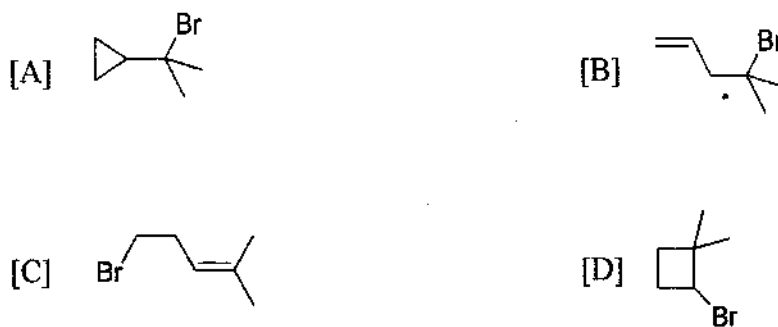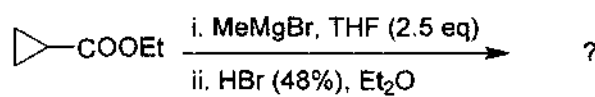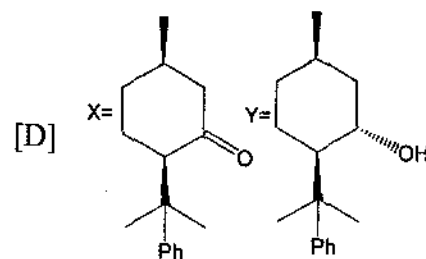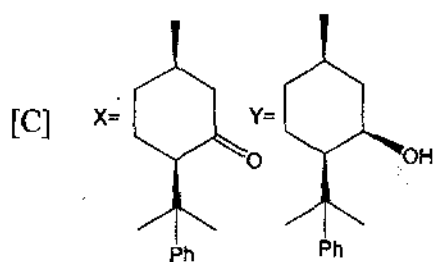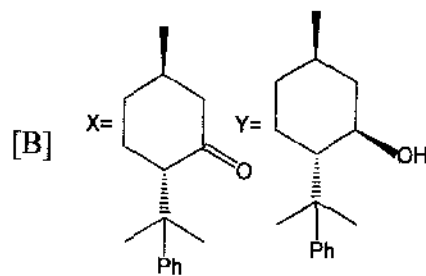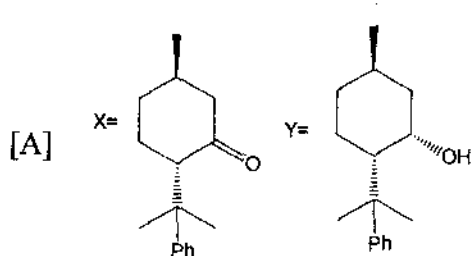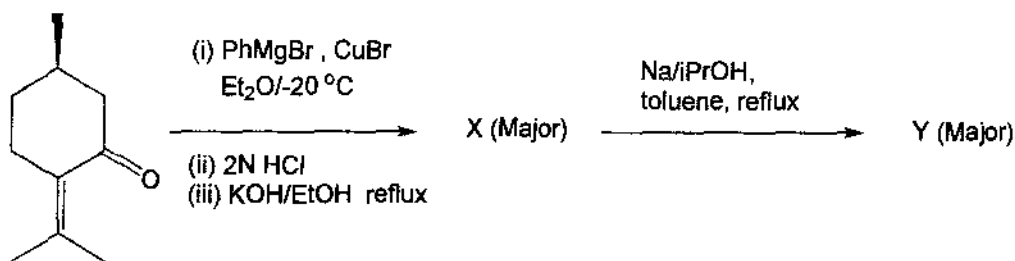
38. Two compounds that do not undergo decarboxylation on heating are:
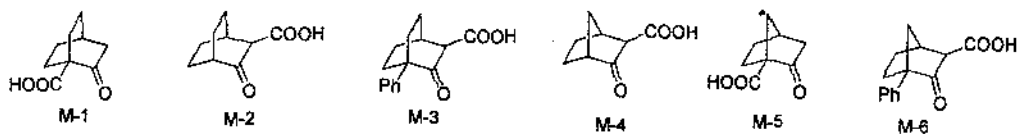
[A] M-1 and M-2

[B] M-3 and M-4

[C] M-1 and M-5

[D] M-1 and M-6

39. The products **X** and **Y** formed in the following reaction sequence are:

[A] [B] [C] [D]
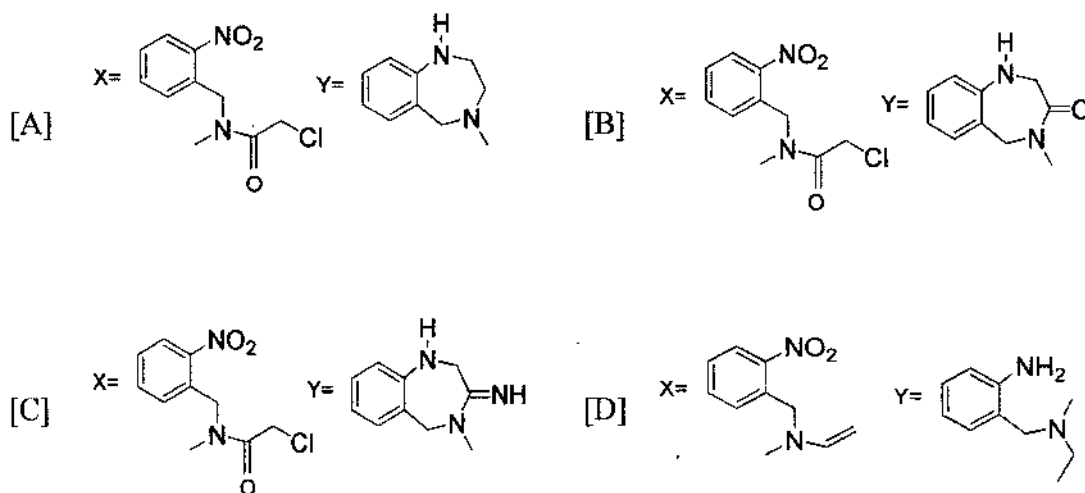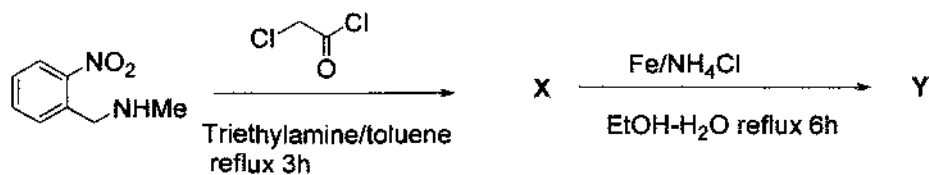
40. The products **X** and **Y** formed in the following reaction sequence are:

[A] [B] [C] [D]
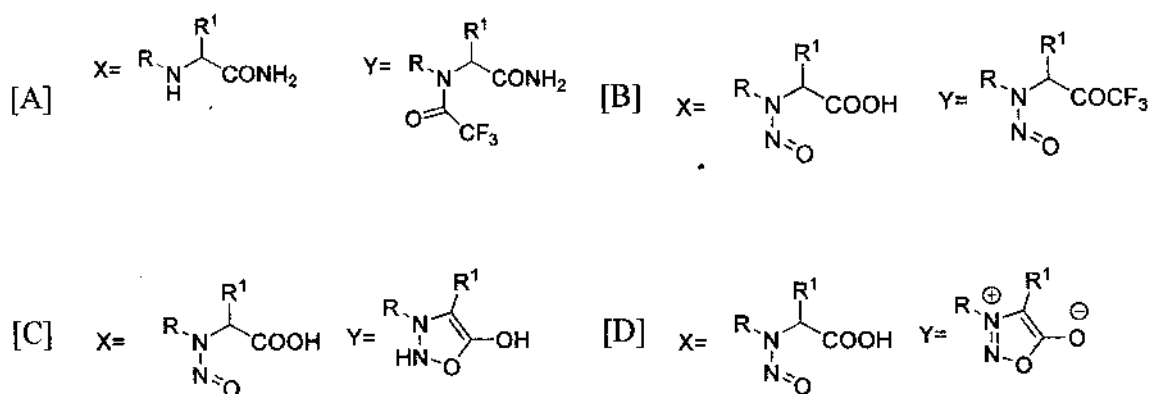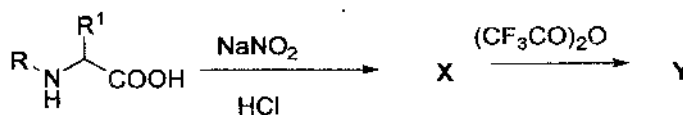
41. In Mn_3O_4, the number of manganese ions in tetrahedral and octahedral sites, respectively are:

[A] one Mn^{3+} and two Mn^{2+}.

[B] one Mn^{2+} and two Mn^{3+}.

[C] two Mn^{3+} and one Mn^{2+}.

[D] two Mn^{2+} and one Mn^{3+}.

42. The binding modes of NO in the 18 electron compounds $[Co(CO)_3(NO)]$ and $[Ni(\eta^5-C_5H_5)(NO)]$, respectively are:

[A] bent and linear.

[B] linear and bent.

[C] bent and bent.

[D] linear and linear.

43. The ground states for V^{2+} in tetrahedral and octahedral crystal fields are, respectively:

[A] $^4T_{1g}$ and $^4A_{2g}$.

[B] $^4T_1$ and $^4A_{2g}$.

[C] $^4A_{2g}$ and $^4T_{1g}$.

[D] $^4A_2$ and $^4T_{1g}$.

44. The stability for the Lewis acid-base adducts $X_3BN(CH_3)_3$ (X = halogen) decreases in the order:

[A] I > Br > Cl > F.

[B] F > Cl > Br > I.

[C] Cl > Br > I > F.

[D] Br > Cl > F > I.

45. Given the potentials for the following reactions, the correct statement is:

(i) $Fe(s) + Cl_2(aq) \rightleftharpoons Fe^{2+}(aq) + 2Cl^-(aq)$; $E^\circ_{cell} = 1.80$ V
(ii) $2Fe(s) + 3Cl_2(aq) \rightleftharpoons 2Fe^{3+}(aq) + 6Cl^-(aq)$; $E^\circ_{cell} = 1.40$ V

[A] While the forward reaction is favored in (ii), the reverse reaction is favored in (i).

[B] Reaction (i) is more favorable than reaction (ii).

[C] Reaction (ii) is more favorable than reaction (i).

[D] While the forward reaction is favored in (i), the reverse reaction is favored in (ii).

46. The total number of lone pairs of electrons in XeF_2 and N_2F_2 are, respectively:

[A] 8 and 9

[B] 9 and 8

[C] 3 and 2

[D] 2 and 3

47. The isomers *cis*-[PtCl$_2$(NH$_3$)(NO$_2$)]$^-$ and *trans*-[PtCl$_2$(NH$_3$)(NO$_2$)]$^-$ can be prepared readily by:

[A] starting with [PtCl$_4$]$^{2-}$
[B] starting with [Pt(NH$_3$)$_4$]$^{2+}$
[C] starting with [PtCl$_4$]$^{2-}$ and [Pt(NH$_3$)$_4$]$^{2+}$, respectively
[D] starting with [PtCl$_4$]$^{2-}$ and [Pt(NH$_3$)$_4$]$^{2+}$, respectively

48. Consider the self-exchange electron transfer reactions between (a) [Fe(bpy)$_3$]$^{2+}$ and [Fe(bpy)$_3$]$^{3+}$ and (b) [Co(NH$_3$)$_6$]$^{2+}$ and [Co(NH$_3$)$_6$]$^{3+}$. The correct statements from the following are:
(i) Reaction (a) is faster than reaction (b).
(ii) Reaction (a) is slower than reaction (b).
(iii) Reaction (a) is outer sphere electron transfer reaction while reaction (b) is inner sphere electron transfer reaction.
(iv) Both (a) and (b) are outer sphere electron transfer reactions.

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

49. The unit cell parameters of monoclinic and triclinic systems are, respectively:

[A] $a = b \neq c$, $\alpha = \beta = \gamma = 90°$ and $a \neq b \neq c$, $\alpha = \beta = \gamma = 90°$.
[B] $a \neq b \neq c$, $\alpha = \beta = \gamma = 90°$ and $a = b = c$, $\alpha = \beta = \gamma \neq 90°$.
[C] $a \neq b \neq c$, $\alpha = \gamma = 90°$, $\beta \neq 90°$ and $a \neq b \neq c$, $\alpha \neq 90°$, $\beta \neq 90°$, $\gamma \neq 90°$.
[D] $a = b = c$, $\alpha = \beta = \gamma = 90°$ and $a = b \neq c$, $\alpha = \beta = 90°$, $\gamma = 120°$.

50. The four enzymatic reactions given below are catalyzed . by four different metalloenzymes. The enzymes are, respectively:

(i) $2O_2^- + 2H^+ \rightarrow O_2 + H_2O_2$
(ii) $RCH_2OH + O_2 \rightarrow RCHO + H_2O_2$
(iii) $2H_2O_2 \rightarrow O_2 + 2H_2O$
(iv) $R_3CH + O_2 + 2$ reduced ferridoxins $\rightarrow R_3COH + 2$ oxidized ferridoxins

[A] superoxide dismutase, catalase, galactose oxidase and xanthine oxidase.
[B] superoxide dismutase, alcohol hydrogenase, cytochrome P-450 and galactose oxidase.
[C] catalase, alcohol hydrogenase, haloperoxidase and galactose oxidase.
[D] superoxide dismutase, galactose oxidase, catalase and cytochrome P-450.

51. An official of a cool-drinks company asked a chemistry student to find out the phosphorus content in a sample of their drink. The student decided to do a spectrophotometric measurement on it to find out the quantity of the phosphorus content. The concerned experiment involved is:

[A] a cobalt salt + hydrogen peroxide + sample cool-drinks.

[B] a molybdate salt + ascorbic acid + sample cool-drinks.

[C] a magnesium salt + ammonia solution + sample cool-drinks.

[D] a managenese salt + hydrogen peroxide + sulfuric acid + sample cool-drinks.

52. The preferred cations for [18]crown-6 and [21]crown-7 are, respectively:

[A] Na^+ and K^+ [B] Na^+ and Cs^+

[C] K^+ and Cs^+ [D] K^+ and Rb^+

53. In general, the increasing order of strength of the supramolecular interactions, ion-dipole, π-π stacking and van der Waals forces, is:

[A] ion-dipole < π-π stacking < van der Waals forces.

[B] van der Waals forces < π-π stacking < ion-dipole.

[C] π-π stacking < Ion-dipole < van der Waals forces.

[D] van der Waals forces < ion-dipole < π-π stacking.

54. The correct notation representing 'side-on bridge' coordination mode of N_2 ligand is:

[A] μ_2-η^2,η^2 [B] μ_2-η^1,η^1

[C] μ_2-η^2 [D] μ_1-η^2,η^2

55. The hapticity (i.e. 'n' value in η^n) of C_8H_8 in $Cr(CO)_3(\eta^n$-$C_8H_8)$ is:

[A] 2   [B] 6

[C] 3   [D] 4

56. The number of lines expected in the X-band ESR spectrum of vanadyl bis(acetylacetonate) in solution at 25°C is:

[A] 4   [B] 2

[C] 6   [D] 8

57. 50 mL of 0.05 M NaCN is titrated with 0.10 M HCl. The pH of the solution at equivalence point is (K_a of HCN = 6.2×10^{-10}) close to:

[A] 7.00

[B] 9.21

[C] 5.34

[D] 1.00

58. The number of skeletal electron pairs in $C_2B_7H_{13}$, and its structure are, respectively:

[A] 12, hypho

[B] 12, nido

[C] 11, arachno ·

[D] 12, arachno

59. The reaction of Zn_3P_2 with H_2O provides:

[A] $[Zn(HPO_3)]_n$

[B] PH_3

[C] $[Zn_2(PO_4)]_n$

[D] $H_3PO_4 + ZnO$

60. The magnetic moments (in BM) expected for Ce^{3+} and Gd^{3+} are, respectively:

[A] 2.54 and 7.94

[B] 3.58 and 9.72

[C] 3.62 and 6.60

[D] 2.68 and 9.72

61. The excitation energy of a particle trapped in a one-dimensional box, while going from the ground state to the first excited state, is 1.2 eV. The energy required to go from first excited state to the second excited state would be (in eV):

[A] 0.5

[B] 1.0

[C] 1.5

[D] 2.0

62. The number of fundamental transitions expected in the IR spectrum of formaldehyde (the relevant character table is given below) is:

C_{2v}	E	C_2	σ_v	$\sigma_v{}'$	
A_1	1	1	1	1	z
A_2	1	1	-1	-1	R_z
B_1	1	-1	1	-1	x, R_y
B_2	1	-1	-1	1	y, R_x

[A] 3

[B] 4

[C] 5

[D] 6

63. The electronic orbital angular momentum (in units of $\hbar$) of nitric oxide in its ground state, along the molecular axis, is:

[A] 0

[B] 1

[C] 2

[D] 3

64. On melting, the volume of solid A increases while that of solid B decreases. Upon increasing the pressure, the melting temperature of A and B will:

[A] increase and decrease, respectively

[B] increase in both cases

[C] decrease in both cases

[D] decrease and increase, respectively

65. In the X-ray ($\lambda = 1.54$ Å) diffraction experiment on a crystal, one peak is observed at 2θ = 80.0°. If an electron diffraction experiment is carried out on the same crystal using electrons with kinetic energy = 50 keV (assume no relativistic correction for the wavelength), this diffraction will be observed at the 2θ value of:

[A] 80.0°

[B] 40.0°

[C] 6.5°

[D] 2.6°

66. Rate constant of a reaction increases by 2% for a 0.1° rise in temperature at 25°C. The standard heat of reaction is 121.6 kJ mol^{-1}. The activation energy (in kJ mol^{-1}) for the reverse reaction is:

[A] 24.7

[B] 20.7

[C] 27.4

[D] 20.4

67. The process of nucleation and crystal growth is controlled by the relative values of the volume free energy (G_V) and surface free energy (G_S); the very small nuclei formed initially are unstable because:

[A] $|G_S| > |G_B|$

[B] $|G_S| = |G_B|$

[C] $|G_S| < |G_B|$

[D] $G_S = G_B = 0$

68. For a one dimensional harmonic oscillator, the commutator of the Hamiltonian with inversion operator, $[\hat{H}, \hat{\imath}]$ is:

[A] -1

[B] $-i\hbar$

[C] 0

[D] $2\pi i\hbar$

69. The activation energy of a reaction is 0.1 kcal mol^{-1} at 325 K. The fraction of reactant molecules that have enough energy to cross the activation barrier is close to:

[A] 0.99

[B] 0.10

[C] 0.86

[D] 0.78

70. A spherical liquid drop weighing 0.04 g is dispersed into 1000 microspheres of radius 0.02 cm. If the density and surface tension of the liquid are 0.8 g cm^{-3} and 27 dynes cm^{-1}, then the increase of the surface energy (in ergs) due to the dispersion is:

[A] 135.8

[B] 17.73

[C] 0.135

[D] 118.1

71. In a reaction, the concentration of a reactant is measured at different time intervals and the results are given below.

Time (min)	0	5	10
Concentration (mM)	40	20	10

The rate constant of this reaction is close to:

[A] 0.14 min

[B] 0.14 min^{-1}

[C] 0.50 min^{-1}

[D] 0.50 min

72. Kinetic salt effect relates to the variation of the rate constant of a reaction between ions with the:

[A] pH of the solution.

[B] ionic strength of the solution.

[C] temperature of the solution.

[D] the viscosity of the solution.

73. The expression for the partition function of a particle is given by $q = \frac{1}{1-e^{-\beta\epsilon}}$. The average energy of N such non-interacting particles is: (where $\beta = 1/k_BT$)

[A] $\dfrac{N\epsilon}{e^{-\beta\epsilon}-1}$

[B] $\dfrac{N\epsilon}{e^{\beta\epsilon}-1}$

[C] $\dfrac{\epsilon}{e^{N\beta\epsilon}-1}$

[D] $\dfrac{\epsilon}{e^{-N\beta\epsilon}-1}$

74. The rotational temperature (in K) for H_2 with rotational constant 60.6 cm^{-1} is nearly equal to:

[A] 67.3

[B] 77.3

[C] 87.3

[D] 97.3

75. The staggered conformation of ethane belongs to the point group:

[A] C_{3h}

[B] D_{3d}

[C] D_{3h}

[D] C_{3v}

76. The correct commutator relationship among the following is:

[A] $\left[\hat{L}^2, \hat{L}_x\right] = 0$

[B] $\left[\hat{L}_x, \hat{L}_y\right] = \left[\hat{L}_y, \hat{L}_z\right]$

[C] $\left[\hat{L}^2, \hat{L}_x^2\right] = 0$

[D] $\left[\hat{L}_z, \hat{L}_x\right] = 0$

77. The fundamental transition in the IR spectrum of $^{75}Br^{19}F$ occurs at 380 cm^{-1}. The force constant of $^{75}Br^{19}F$ in $N\ m^{-1}$ is:

[A] 119

[B] 139

[C] 129

[D] 109

78. A Langmuir adsorption isotherm (K is the equilibrium constant for adsorption) is plotted as $\frac{1}{\theta}$ vs. $\frac{1}{p}$ (θ is the fractional surface coverage of the adsorbent and p is the equilibrium pressure of the gas adsorbed). Slope of the plot is:

[A] $\dfrac{1}{K}$

[B] K^2

[C] $\dfrac{1}{K^2}$

[D] K

79. If the voltage of a Zn-H$^+$ cell is 0.45 V at 25°C when [Zn^{2+}] = 1.0 M and p_{H_2} = 1.0 atm, then the concentration of H$^+$ is: ($E^0_{Zn^{2+}/Zn}= -0.76$ V)

[A] 9.5×10^{-6} M

[B] 5.8×10^{-6} M

[C] 7.5×10^{-6} M

[D] 10.8×10^{-6} M

80. When ethanol (density = 0.789 g cm^{-3}) freezes at −3.6°C, its density increases by 3.8%. If its enthalpy of fusion is 8.7 kJ mol^{-1} then its freezing point at 10 MPa is close to:

[A] 300.50 K

[B] 270.25 K

[C] 100 K

[D] 400 K

*********************End*********************

University of Hyderabad
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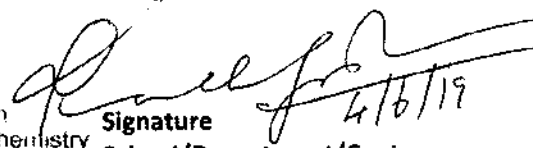
School/Department/Centre : **CHEMISTRY**

Course/Subject : **Ph.D. Chemistry**

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

Note/Remarks :

1. Due to a minor typing error, question no. 8 has a mistake. So the benefit may be given to all students for this question.
2. All other challenges are found to be incorrect; the correct options provided earlier stand.

Dean
School of Chemistry **Signature** 4/6/19