GATE 2007
CY: Chemistry

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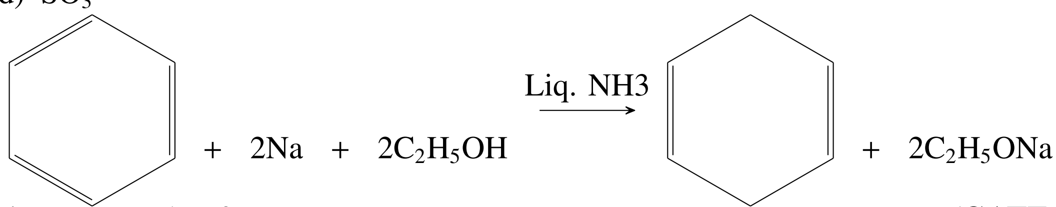
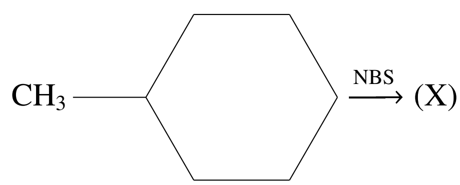
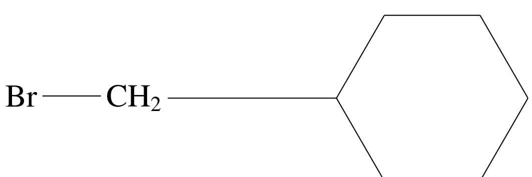
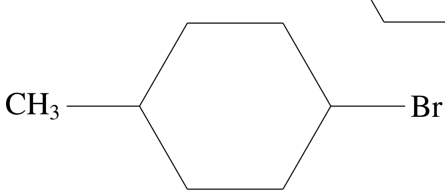
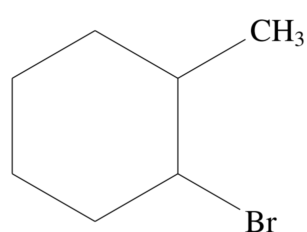
1) The rate of sulphonation of benzene can be significantly enhanced by the use of (**GATE CY 2007**)
   a) a mixture of HNO_3 and H_2SO_4
   b) conc. H_2SO_4
   c) a solution of SO_3 in H_2SO_4
   d) SO_3
2) 

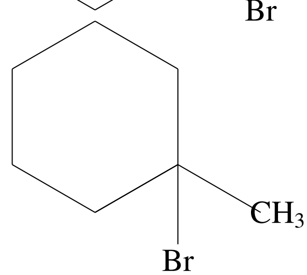
   is an example of (**GATE CY 2007**)
   a) Birch reduction
   b) Clemmenson reduction
   c) Wolff-Kishner reduction
   d) Hydride reduction
3) The major product (X) of the monobromination reaction is (**GATE CY 2007**)



   a) 

   b) 

   c) 

   d) 

4) Benzene can not be iodinated with I2 directly. However, in presence of oxidants such as HNO3, iodination is possible. The electrophile formed in this case is (**GATE CY 2007**)

a) $[I^+]$ b) $[I^-]$ c) $\left[{}^{\delta+}I \cdots {}^{\delta+}OH_2\right]^+$ d) $\left[{}^{\delta+}I \cdots {}^{\delta-}OH_2\right]^+$

5) Classification of species as Electrophiles (E) and Nucleophiles (N) (**GATE CY 2007**)
Given species: SO_3, Cl^+, CH_3NH_2, H_3O^+, BH_3, CN^-

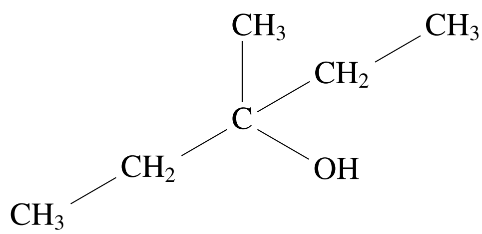
a) E = SO_3, Cl^+, BH_3 ; N = CH_3NH_2, H_3O^+, CN^-

b) E = Cl^+, H_3O^+ ; N = SO_3, CH_3NH_2, BH_3, CN^-

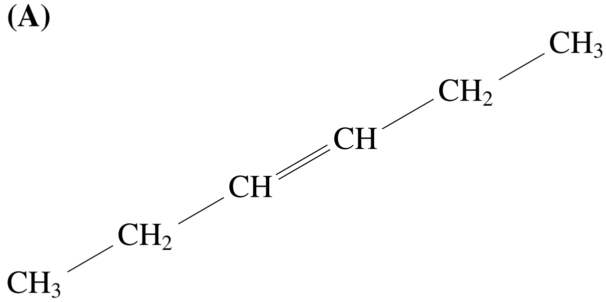
c) E = Cl^+, H_3O^+, BH_3 ; N = SO_3, CH_3NH_2, H_3O^+, CN^-

d) E = SO_3, Cl^+, H_3O^+, BH_3 ; N = CH_3NH_2, CN^-

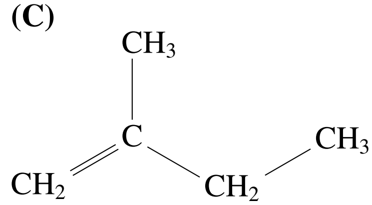
6) The major product obtained upon treatment of compound X with H_2SO_4 at 80°C is (**GATE CY 2007**)
(X)



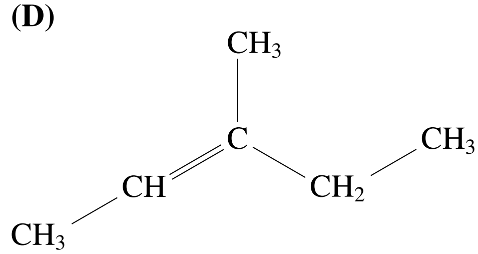
(A)



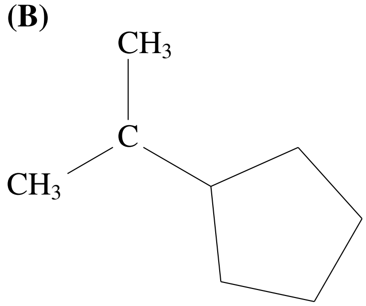
(C)



(D)



(B)



7) $BaTi[Si_3O_9]$ is a class of (**GATE CY 2007**)

a) ortho silicate b) cyclic silicate c) chain silicate d) sheet silicate

8) The ground state term for V^{3+} ion is (**GATE CY 2007**)

a) ^3F b) ^2F c) ^3P d) ^2D

9) In photosynthesis, the predominant metal present in the reaction centre of photosystem II is (**GATE CY 2007**)

a) Zn b) Cu c) Mn d) Fe

10) The octahedral complex / complex ion which shows both facial and meridional isomers is (**GATE CY 2007**)

a) Triglycinatocobalt(III)
b) Tris(ethylenediamine)cobalt(III)
c) Dichlorodiglycinatocobalt(III)
d) Trioxalatocobaltate(III)

11) Zn in carbonic anhydrase is coordinated by three histidine and one water molecule. The reaction of CO_2 with this enzyme is an example of (**GATE CY 2007**)

a) electrophilic addition
b) electron transfer
c) nucleophilic addition
d) electrophilic substitution

12) The difference in the measured and calculated magnetic moment (based on spin-orbit coupling) is observed for (**GATE CY 2007**)

a) Pm^{3+}
b) Eu^{3+}
c) Dy^{3+}
d) Lu^{3+}

13) For a redox reaction, $Cd^{2+} + 2\,e^- \longrightarrow Cd$, the $E_{p,\text{ anodic}}$ observed in cyclic voltammetry at hanging mercury drop electrode is –650 mV vs. SCE. The expected value for $(E_p)_{\text{cathodic}}$ is (**GATE CY 2007**)

a) –708 mV
b) –679 mV
c) –650 mV
d) –621 mV

14) The dimension of Planck constant is (M, L and T denote mass, length and time respectively) (**GATE CY 2007**)

a) ML^2T^{-2}
b) ML^2T^{-1}
c) $M^2L^{-1}T^{-1}$
d) $M^{-1}L^2T^{-2}$

15) For a homonuclear diatomic molecule, the bonding molecular orbital is (**GATE CY 2007**)

a) σ_u of lowest energy
b) σ_u of second lowest energy
c) π_g of lowest energy
d) π_u of lowest energy

16) The selection rules for the appearance of P branch in the rotational-vibrational absorption spectra of a diatomic molecule within rigid rotor-harmonic oscillator model are (**GATE CY 2007**)

a) $\Delta v = \pm 1$ and $\Delta J = \pm 1$
b) $\Delta v = +1$ and $\Delta J = +1$
c) $\Delta v = +1$ and $\Delta J = -1$
d) $\Delta v = -1$ and $\Delta J = -1$

17) The S_2 operation on a molecule with the axis of rotation as the z axis, moves a nucleus at (x, y, z) to **(GATE CY 2007)**

a) (-x, -y, z)
b) (x, -y, -z)
c) (-x, y, -z)
d) (-x, -y, -z)

18) The expression which represents the chemical potential of the i^{th} species (μ_i) in a mixture ($i \neq j$) is **(GATE CY 2007)**

a) $\left(\frac{\partial E}{\partial n_i}\right)_{S,V,n_j}$
b) $\left(\frac{\partial H}{\partial n_i}\right)_{S,P,n_j}$
c) $\left(\frac{\partial A}{\partial n_i}\right)_{T,V,n_j}$
d) $\left(\frac{\partial G}{\partial n_i}\right)_{T,P,n_j}$

19) Which of the following statements is **NOT** correct for a catalyst? **(GATE CY 2007)**

a) It increases the rate of a reaction
b) It is not consumed in the course of a reaction
c) It provides an alternate pathway for the reaction
d) It increases the activation energy of the reaction

20) The value of the rate constant for the gas phase reaction $_2NO_2 + F_2 \longrightarrow {}_2NO_2F$ is 38 dm^3 mol^{-1} s^{-1} at 300K. The order of the reaction is **(GATE CY 2007)**

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

21) Boric acid in aqueous solution in presence of glycerol behaves as a strong acid due to the formation of **(GATE CY 2007)**

a) an anionic metal-chelate
b) borate anion
c) glycerate ion
d) a charge transfer complex

22) Match the compounds in **List I** with the corresponding structure / property given in **List II** **(GATE CY 2007)**

List I	List II
(a) $(Ph_3P)_3RhCl$	(i) Spinel
(b) $LiCl_6$	(ii) Intercalation
(c) PtF_6	(iii) Oxidising agent
(d) Ni_3S_4	(iv) Catalyst for alkane hydrogenation

a) a - iii b - i c - ii d - iv
b) a - iv b - ii c - iii d - i
c) a - iii b - ii c - ii d - iv
d) a - iv b - iii c - ii d - i

23) $W(CO)_6$ reacts with MeLi to give an intermediate which upon treatment with CH_2N_2 gives a compound **X**. **X** is represented as **(GATE CY 2007)**

a) WMe_6
b) $(CO)_5W\text{-}Me$
c) $(CO)_5W{=}C(Me)OMe$
d) $(CO)_5W = CMe$

24) Considering the quadrupolar nature of M-M bond in $[Re_2Cl_8]^{2-}$, the M-M bond order in $[Re_2Cl_4(PMe_2Ph)_4]^+$ and $[Re_2Cl_4(PMe_2Ph)_4]$ respectively are (**GATE CY 2007**)

a) 3.0 and 3.0
b) 3.0 and 3.5
c) 3.5 and 3.5
d) 3.5 and 3.0

25) A student recorded a polarogram of 2.0 mM Cd^{2+} solution and forgot to add KCl solution. What type of error do you expect in his results? (**GATE CY 2007**)

a) Only migration current will be observed
b) Only diffusion current will be observed
c) Both migration current as well as diffusion current will be observed
d) Both catalytic current as well as diffusion current will be observed

26) The separation of trivalent lanthanide ions, Lu^{3+}, Yb^{3+}, Dy^{3+}, Eu^{3+} can be effectively done by a cation exchange resin using ammonium *o*-hydroxy isobutyrate as the eluent. The order in which the ions will be separated is (**GATE CY 2007**)

a) Lu^{3+}, Yb^{3+}, Dy^{3+}, Eu^{3+}
b) Eu^{3+}, Dy^{3+}, Yb^{3+}, Lu^{3+}
c) Dy^{3+}, Yb^{3+}, Eu^{3+}, Lu^{3+}
d) Yb^{3+}, Dy^{3+}, Lu^{3+}, Eu^{3+}

27) Arrange the following metal complexes in order of their increasing hydration energy (**GATE CY 2007**)

$$[Mn(H_2O)_6]^{2+}{}_P \quad [V(H_2O)_6]^{2+}{}_Q \quad [Ni(H_2O)_6]^{2+}{}_R \quad [Ti(H_2O)_6]^{2+}{}_S$$

a) $P < S < Q < R$
b) $P < Q < R < S$
c) $Q < P < R < S$
d) $S < R < Q < P$

28) In the complex, $[Ni_2(n^5\text{-}Cp)_2(CO)_2]$, the IR stretching frequency appears at 1857 cm^{-1} (strong) and 1897 cm^{-1} (weak). The valence electron count and the nature of the M-CO bond respectively are (**GATE CY 2007**)

a) 16 e^-, bridging
b) 17 e^-, bridging
c) 18 e^-, terminal
d) 18 e^-, bridging

29) The correct classification of $[B_5H_5]^{2-}$, B_5H_9 and B_5H_{11} respectively is (**GATE CY 2007**)

a) closo, arachno, nido
b) arachno, closo, nido
c) closo, nido, arachno
d) nido, arachno, closo

30) The compounds **X** and **Y** in the following reaction are (**GATE CY 2007**)

$$P_4S_{10} \xrightarrow{\text{EtOH}} (X) \xrightarrow{Cl_2} (Y) \xrightarrow{\text{p-}O_2NC_6H_4ONa} \text{Paration}$$

a) X = $(Et)_2P(S)SH$; Y = $(EtO)_2P(S)Cl$
$(Et)_2P(S)Cl$
b) X = $(EtO)_2P(S)SH$; Y =
c) $X = (EtO)_2PSH$; $Y = (EtO)_2PCl$
d) $X = (Et)_3PO$; $Y = (Et)_3PCl$

31) Consider the reactions **(GATE CY 2007)**
a) $[Cr(H_2O)_6]^{2+} + [CoCl(NH_3)_5]^{2+} \rightarrow [Co(NH_3)_5(H_2O)]^{3+} + [CrCl(H_2O)_5]^{2+}$
b) $[Fe(CN)_6]^{4-} + [Mo(CN)_8]^{3-} \rightarrow [Fe(CN)_6]^{3-} + [Mo(CN)_8]^{4-}$
Which one of the following is the correct statement?

a) Both involve an inner sphere mechanism
b) Both involve an outer sphere mechanism
c) Reaction 1 follows outer sphere and reaction 2 follows inner sphere mechanism
d) Reaction 1 follows inner sphere and reaction 2 follows outer sphere mechanism

32) The pair of compounds having the same hybridization for the central atom is (**GATE CY 2007**)

a) XeF_4 and $[SiF_6]^{2-}$
b) $Ni(CO)_4$ and XeO_2F_2
$NiCl_4$ $^{2-}$ and $[PtCl_4]^{2-}$
$Co(NH_3)_6$ $^{3+}$ and $[Co(H_2O)_6]^{3+}$

33) In the reaction shown below, X and Y respectively are **(GATE CY 2007)**

$$Mn_2(CO)_{10} \xrightarrow{\text{Na}} (X) \xrightarrow{\text{CH}_3\text{COCl}} (Y)$$

$Mn(CO)_4$ $^{2-}$, $[CH_3C(O)Mn(CO)_5]^-$
$Mn(CO)_5$ $^{-}$, $C1Mn(CO)_5$
$Mn(CO)_5$ $^{-}$, $CH_3C(O)Mn(CO)_5$
$Mn(CO)_4$ $^{2-}$, $C1Mn(CO)_5$

34) The Lewis acid character of BF_3, BCl_3 and BBr_3 follows the order **(GATE CY 2007)**

a) BF_3 ¡ BBr_3 ¡ BCl_3
c) BF_3 ¡ BCl_3 ¡ BBr_3
b) BCl_3 ¡ BBr_3 ¡ BF_3
d) BBr_3 ¡ BCl_3 ¡ BF_3

35) The compound which shows L←M charge transfer is **(GATE CY 2007)**

a) $Ni(CO)_4$
c) HgO
b) $K_2Cr_2O_7$
$Ni(H_2O)_6$ $^{2+}$

36) The reaction of $[PtCl_4]^{2-}$ with NH_3 gives rise to **(GATE CY 2007)**

$PtCl_2(NH_3)_2$ $^{2-}$
$PtCl_2(NH_3)_4$
a) trans-$[PtCl_2(NH_3)_2]$
b) cis-$[PtCl_2(NH_3)_2]$

37) Zeise's salt is represented as **(GATE CY 2007)**

a) H_2PtCl_6
$ZnCl_4$ $^{2-}$
$PtCl_4$ $^{2-}$
$PtCl_3(\eta^2\text{-}C_2H_4)$ $^{-}$

38) The catalyst used in the conversion of ethylene to acetaldehyde using Wacker process is (**GATE CY 2007**)

a) $H_2Co(CO)_4$
b) $PdCl_4^{2-}$
c) V_2O_5
d) $TiCl_4$ in presence of $Al(C_2H_5)_3$

39) The temperature of 54 g of water is raised from 15°C to 75°C at constant pressure. The change in the enthalpy of the system (given that $C_{p,m}$ of water = 75 J K^{-1} mol^{-1}) is (**GATE CY 2007**)

a) 4.5 kJ
b) 13.5 kJ
c) 9.0 kJ
d) 18.0 kJ

40) The specific volume of liquid water is 1.0001 mL g^{-1} and that of ice is 1.0907 mL g^{-1} at 0°C. If the heat of fusion of ice at this temperature is 333.88 J g^{-1}, the rate of change of melting point of ice with pressure in deg atm^{-1} will be (**GATE CY 2007**)

a) −0.0075
b) 0.0075
c) 0.075
d) −0.075

41) Given that $E°(Fe^{3+}, Fe^{2+}) = -0.04$ V and $E°(Fe^{2+}, Fe) = -0.44$ V, the value of $E°(Fe^{3+}, Fe)$ is (**GATE CY 2007**)

a) 0.76 V
b) −0.40 V
c) −0.76 V
d) 0.40 V

42) For the reaction P + Q + R → S, experimental data for the measured initial rates is given below (**GATE CY 2007**)

Expt.	Initial conc. P (M)	Initial conc. Q (M)	Initial conc. R (M)	Initial rate (M s^{-1})
1	0.2	0.5	0.4	8.0×10^{-3}
2	0.4	0.5	0.4	3.2×10^{-2}
3	0.4	0.25	0.4	1.28×10^{-2}
4	0.1	0.25	1.6	4.0×10^{-3}

The order of the reaction with respect to P, Q and R respectively is

a) 2, 2, 1
b) 2, 1, 2
c) 2, 1, 1
d) 1, 1, 2

43) Sucrose is converted to a mixture of glucose and fructose in a pseudo first order process under alkaline conditions. The reaction has a half life of 28.4 min. The time required for the reduction of a 8.0 mM sample of sucrose to 1.0 mM is (**GATE CY 2007**)

a) 56.8 min
b) 170.4 min
c) 85.2 min
d) 227.2 min

44) The reaction (**GATE CY 2007**)

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

proceeds via the following steps

$$NO + NO \xrightarrow{K_a} N_2O_2$$
$$N_2O_2 \xrightarrow{K_{a'}} NO + NO$$
$$N_2O_2 + O_2 \xrightarrow{k_b} NO_2 + NO_2$$

The rate of this reaction is equal to

a) $2k_b[NO]^2[O_2]$
b) $\frac{2k_a k_b[NO]^2[O_2]}{(k_{-f}+k_b[O_2])}$
c) $2k_b[NO]^2[O_2]$
d) $k_b[NO]^2[O_2]$

45) 40 millimoles of NaOH are added to 100 mL of a 1.2 M HA and Y M NaA buffer resulting in a solution of pH 5.30. Assuming that the volume of the buffer remains unchanged, the pH of the buffer ($K_{HA} = 1.00 \times 10^{-5}$) is **(GATE CY 2007)**

a) 5.30
b) 5.00
c) 0.30
d) 10.30

46) The entropy of mixing of 10 moles of helium and 10 moles of oxygen at constant temperature and pressure, assuming both to be ideal gases, is **(GATE CY 2007)**

a) 115.3 J K^{-1}
b) 5.8 J K^{-1}
c) 382.9 J K^{-1}
d) 230.6 J K^{-1}

47) The ionisation potential of hydrogen atom is 13.6 eV. The first ionisation potential of a sodium atom, assuming that the energy of its outer electron can be represented by a H-atom like model with an effective nuclear charge of 1.84, is **(GATE CY 2007)**

a) 46.0 eV
b) 11.5 eV
c) 5.1 eV
d) 2.9 eV

48) The quantum state of a particle moving in a circular path in a plane is given by

$$\Psi_m(\phi) = (1/\sqrt{2\pi})e^{im\phi}, m = 0, \pm1, \pm2, ...$$

When a perturbation $H_1 = P\cos\phi$ is applied (P is a constant), what will be the first order correction to the energy of the m^{th} state **(GATE CY 2007)**

a) 0
b) $P(2\pi)$
c) $P(4\pi)$
d) $Pm^2(4\pi^2)$

49) The correct statement(s) among the following is/are
(i) The vibrational energy levels of a real diatomic molecule are equally spaced.
(ii) At 500k, the reaction A → B is spontaneous when ΔH = 18.83 kj mol^{-1} and ΔS = 41.84 J K^{-1} mol^{-1}.
(iii) The process of fluorescence involves transition from a singlet electronic state to another singlet electronic state by absorption of light.
(iv) When a constant P is added to each of the possible energies of a system, its entropy remains unchanged.
(GATE CY 2007)

a) only i
b) only ii
c) both i and iii
d) both ii and iv

50) Assuming H_2 and HD molecules having equal bond lengths, the ratio of the rotational partition functions of these molecules, at temperatures above 100K is (**GATE CY 2007**)

a) 3/8
b) 3/4
c) 1/2
d) 2/3

51) N noninteracting molecules are distributed among three nondegenerate energy levels $\varepsilon_0 = 0$, $\varepsilon_1 = 1.38 \times 10^{-21}$ J and $\varepsilon_2 = 2.76 \times 10^{-21}$ J at 100K. If the average total energy of the system at this temperature is 1.38×10^{-18} J, the number of molecules in the system is (**GATE CY 2007**)

a) 1000
b) 1503
c) 2354
d) 2987

52) The $J = 0 \rightarrow 1$ rotational transition for ${}^1H^2D^+$ occurs at 500.72 GHz. Assuming the molecule to be a rigid rotor, the $J = 3 \rightarrow 4$ transition occurs at (**GATE CY 2007**)

a) 50.1 cm^{-1}
b) 66.8 cm^{-1}
c) 16.7 cm^{-1}
d) 83.5 cm^{-1}

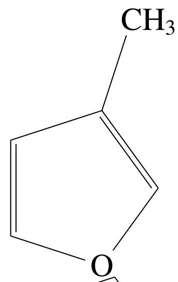
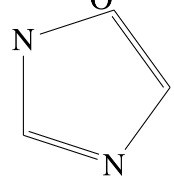
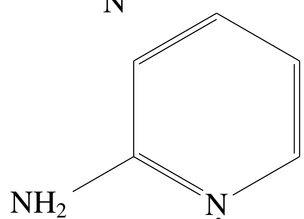
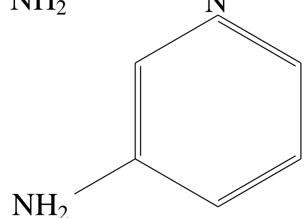
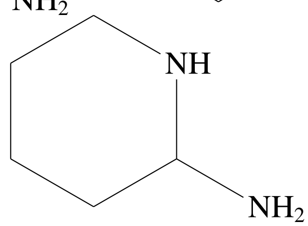
53) The rate constants of two reactions at temperature T are $k_1(T)$ and $k_2(T)$ and the corresponding activation energies are E_1 and E_2 with $E_2 > E_1$. When temperature is raised from T_1 to T_2, which one of the following relations is correct? (**GATE CY 2007**)

a) $\frac{k_1(T_2)}{k_1(T_1)} > \frac{k_2(T_2)}{k_2(T_1)}$
b) $\frac{k_2(T_2)}{k_2(T_1)} > \frac{k_1(T_2)}{k_1(T_1)}$
c) $\frac{k_2(T_1)}{k_2(T_2)} > \frac{k_1(T_2)}{k_1(T_1)}$
d) $\frac{k_1(T_1)}{k_1(T_2)} > \frac{k_2(T_1)}{k_2(T_2)}$

54) The number of degrees of freedom for a system consisting of NaCl(s), Na^+(aq) and Cl^-(aq) at equilibrium is (**GATE CY 2007**)

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

55) Match the structures in **List I** with their correct names given in **List II** (**GATE CY 2007**)

List I	**List II**
(a) 	(i) 2-methyl furan
(b) 	(ii) Imidazole
(c) 	(iii) 5-hydroxybenzothiazole
(d) 	(iv) 2-amino piperidine
(e) 	(v) 2-amino morpholine

Options:

a) a-vii, b-ii, c-vi, d-iii, e-iv
b) a-vii, b-ii, c-vi, d-viii, e-iv
c) a-vii, b-ii, c-vi, d-iii, e-v
d) a-i, b-ii, c-vi, d-iii, e-iv

56) The result of the reduction of either (R) or (S) 2-methylcyclohexanone, in separate reactions, using $LiAlH_4$ is that the reduction of (**GATE CY 2007**)

a) the R enantiomer is stereoselective
b) the R enantiomer is stereospecific
c) the S enantiomer is stereospecific
d) both the R and S enantiomers is stereoselective

57) The increasing order of basicity among the following is (**GATE CY 2007**)

a) Y ¡ X ¡ Z
b) Y ¡ Z ¡ X
c) X ¡ Z ¡ Y
d) X ¡ Y ¡ Z

58) In the reaction (**GATE CY 2007**)

If the concentration of both the reactants is doubled, then the rate of the reaction will

a) remain unchanged
b) quadruple
c) reduce to one fourth
d) double

59) Match the structures in **List I** with the coupling constant [^{1}J] (Hz) given in **List II** (**GATE CY 2007**)

a) a-i b-ii c-iii
b) a-ii b-iii c-i
c) a-iii b-ii c-i
d) a-iii b-i c-ii

60) The mono protonation of adenine (X) in acidic solution (**GATE CY 2007**)
Mainly occurs at

a) position 1
b) position 2
c) position 3
d) either position 4 or 5

61) In the following reaction (**GATE CY 2007**)
X and Y respectively are

a) $^{1}{:}CH_2$ and cis 1,2 dimethylcyclopropane
b) $^{3}{:}CH_2$ and cis 1,2 dimethylcyclopropane
c) $^{1}{:}CH_2$ and a mixture of cis/trans 1,2 dimethylcyclopropane
d) $^{3}{:}CH_2$ and a mixture of cis/trans 1,2 dimethylcyclopropane

62) The major products obtained upon treating a mixture of (**GATE CY 2007**)

63) Match the observed principal absorptions in the visible spectrum shown in **List I** with the bond that shows this absorption in **List II** (**GATE CY 2007**)

List I	**List II**
(a) $\sigma \rightarrow \sigma^*$	(i) C – C
(b) $n \rightarrow \sigma^*$	(ii) C – O
(c) n, π^*	(iii) C = O
(d) π, π^*	(iv) C = C

a) a-i b-ii c-iii d-iv
b) a-i b-iii c-ii d-iv
c) a-ii b-i c-iv d-iii
d) a-iv b-ii c-iii d-i

64) The direction of rotation of the following thermal electrocyclic ring closures respectively is (**GATE CY 2007**)

a) disrotatory, disrotatory, disrotatory
b) conrotatory, conrotatory, conrotatory
c) disrotatory, disrotatory, conrotatory
d) disrotatory, conrotatory, disrotatory

65) The molecule(s) that exist as *meso* structure(s) is/are (**GATE CY 2007**)

a) only M
b) both K and L
c) only L
d) only K

66) The stereochemical descriptors for the atoms labeled H_a and H_b in the structures X, Y and Z respectively are (**GATE CY 2007**)

a) X-homotopic, Y-enantiotopic and Z-diastereotopic
b) X-enantiotopic, Y-homotopic and Z-diastereotopic
c) X-diastereotopic, Y-homotopic and Z-enantiotopic
d) X-homotopic, Y-diastereotopic and Z-enantiotopic

67) Treatment of the pentapeptide Gly-Arg-Phe-Ala-Ala, in separate experiments, with the enzymes Trypsin, Chymotrypsin and Carboxypeptidase A respectively, gives (**GATE CY 2007**)

a) Gly-Arg + Phe-Ala-Ala ; Gly-Arg-Phe + Ala-Ala ; Gly-Arg-Phe-Ala + Ala
b) Gly-Arg-Phe + Ala-Ala ; Gly-Arg-Phe + Ala-Ala ; Gly-Arg-Phe-Ala + Ala
c) Gly-Arg + Phe-Ala-Ala ; Gly-Arg-Phe-Ala + Ala ; Gly-Arg-Phe-Ala-Ala
d) Gly-Arg + Phe-Ala-Ala ; Gly-Arg-Phe + Ala-Ala ; Gly + Arg-Phe-Ala + Ala

Common Data for Questions 71, 72, 73:
Trans 1,2 difluoroethylene molecule has a 2-fold rotational axis, a symmetry plane perpendicular to the rotational axis and an inversion centre.

68) The number of distinct symmetry operations that can be performed on the molecule is (**GATE CY 2007**)

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

69) The number of irreducible representations of the point group of the molecule is (**GATE CY 2007**)

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

70) When two H atoms of the above molecule are also replaced by F atoms, the point group of the resultant molecule will be (**GATE CY 2007**)

a) C_i
b) C_{2h}
c) C_{2v}
d) D_{2h}

Common Data for Questions 74, 75:
Reactivity of aryl amines towards electrophilic aromatic substitution is much higher than that of aliphatic amines. Hence differential reactivity of the amino group is desirable in many reactions.

a) *p*-toluenesulphonyl chloride / KOH
b) (i) $NaNO_2$ / HCl, 0-5°C (ii) alkaline β-naphthol
c) Sn / HCl
d) Acetyl chloride

Linked Answer Questions: Q.76 to Q.77 carry two marks each.

71) In the reaction

$$\text{AMP} \xrightarrow[175°\text{C}]{\text{aq. NH}_3} (\text{X}) + H_3PO_4$$

Compound X is (**GATE CY 2007**)

a) Adenine
b) Xanthine
c) 2,6-diaminopurine
d) Adenosine

72) Compound X on treatment with conc. HCl gives (**GATE CY 2007**)

a) Uric acid
b) Adenine
c) Hypoxanthine
d) Guanine

73) The reaction of ammonium chloride with BCl_3 at 140°C followed by treatment with $NaBH_4$ gives the product X. The formula of X is (**GATE CY 2007**)

a) $B_3N_3H_3$
b) $B_3N_3H_6$
c) $B_3N_3H_{12}$
d) $[BH\text{-}NH]_n$

74) Which of the following statement(s) is/are true for X? (**GATE CY 2007**)
(i) X is not isoelectronic with benzene.
(ii) X undergoes addition reaction with HCl.
(iii) Electrophilic substitution reaction on X is much faster than that of benzene.
(iv) X undergoes polymerization at 90°C. (**GATE CY 2007**)

a) i and ii
b) only ii
c) ii and iii
d) i and iv

75) Consider a particle of mass m moving in a one-dimensional box under the potential $V = 0$ for $0 \leq x \leq a$ and $V = \infty$ outside the box. When the particle is in its lowest energy state the average momentum $\langle p_x \rangle$ of the particle is (**GATE CY 2007**)

a) $\langle p_x \rangle = 0$
b) $\langle p_x \rangle = \frac{h}{a}$
c) $\langle p_x \rangle = \frac{h}{2a}$
d) $\langle p_x \rangle = \frac{h}{2\pi a}$

76) The uncertainty in the momentum (Δp_x) of the particle in its lowest energy state is (**GATE CY 2007**)

a) $\Delta p_x = 0$
b) $\Delta p_x = \frac{h}{a}$
c) $\Delta p_x = \frac{h}{2a}$
d) $\Delta p_x = \frac{h}{2\pi a}$

77) In the mixture obtained by mixing 25.0 mL 1.2×10^{-3} M $MnCl_2$ and 35.0 mL of 6.0×10^{-4} M KCl solution, the concentrations (M) of Mn^{2+}, K^+ and Cl^- ions respectively are (**GATE CY 2007**)

a) 6.0×10^{-4}, 3.0×10^{-4}, 1.5×10^{-3}
b) 6.0×10^{-4}, 3.0×10^{-4}, 9.0×10^{-4}
c) 5.0×10^{-4}, 3.5×10^{-4}, 1.35×10^{-3}
d) 5.0×10^{-4}, 3.5×10^{-4}, 8.5×10^{-4}

78) The activity (M) of Mn^{2+} ions in the above solution is (**GATE CY 2007**)

a) 1.0×10^{-4}
b) 2.0×10^{-4}
c) 3.0×10^{-4}
d) 4.0×10^{-4}

END OF THE QUESTON PAPER