2007
CY: Chemistry

Duration : Three Hours | Maximum Marks :150

Read the following instructions carefully.

1. This question paper contains 85 objective type questions. Q.1 to Q.20 carry **one** mark each and Q.21 to Q.85 carry **two** marks each.

2. Attempt all the questions.

3. Questions must be answered on **O**bjective **R**esponse **S**heet (**ORS**) by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number on the left hand side of the **ORS**. **Each question has only one correct answer.** In case you wish to change an answer, erase the old answer completely.

4. Wrong answers will carry NEGATIVE marks. In Q.1 to Q.20, **0.25** mark will be deducted for each wrong answer. In Q.21 to Q.76, Q.78, Q.80, Q.82 and in Q.84, **0.5** mark will be deducted for each wrong answer. However, there is no negative marking in Q.77, Q.79, Q.81, Q.83 and in Q.85. More than one answer bubbled against a question will be taken as an incorrect response. Unattempted questions will not carry any marks.

5. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the **ORS**.

6. Using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your paper code.

7. Calculator is allowed in the examination hall.

8. Charts, graph sheets or tables are NOT allowed in the examination hall.

9. Rough work can be done on the question paper itself. Additionally blank pages are given at the end of the question paper for rough work.

10. This question paper contains **24** printed pages including pages for rough work. Please check all pages and report, if there is any discrepancy.

Some Useful Data

1. Physical Constants

(a) Universal gas constant, $R = 8.3145\ J\ K^{-1}\ mol^{-1} = 0.082\ L\ atm\ K^{-1}\ mol^{-1}$

(b) Planck constant, $h = 6.626 \times 10^{-34}\ J\ s$

(c) Avogadro number, $N = 6.022 \times 10^{23}\ mol^{-1}$

(d) Faraday constant, $F = 96500\ C\ mol^{-1}$

(e) Electron charge, $e = 1.602 \times 10^{-19}\ C$

(f) Speed of light, $c = 2.998 \times 10^{8}\ m\ s^{-1}$

(g) Boltzmann constant, $k_b = 1.381 \times 10^{-23}\ J\ K^{-1}$

2. Atomic Numbers

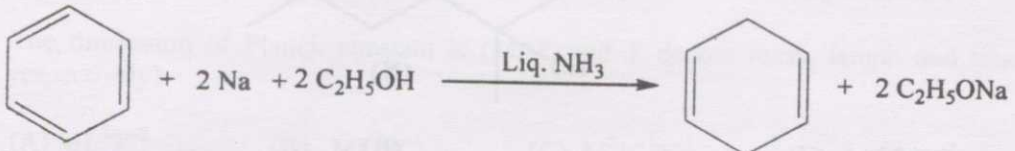
B = 5	Si = 14	Ti = 22
V = 23	Cr = 24	Mn = 25
Co = 27	Ni = 28	Xe = 54
Eu = 63	Dy = 66	Yb = 70
Lu = 71	Re = 75	Pt = 78

Q. 1 – Q. 20 carry one mark each.

Q.1 The rate of sulphonation of benzene can be significantly enhanced by the use of

(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

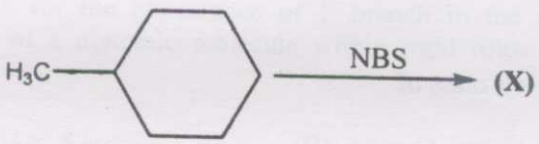
Q.2 The reaction



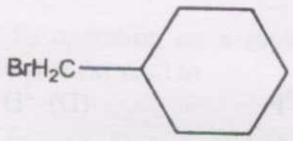
is an example of a

(A) Birch reduction
(B) Clemmenson reduction
(C) Wolff-Kishner reduction
(D) hydride reduction

Q.3 The major product (**X**) of the monobromination reaction is



(A)



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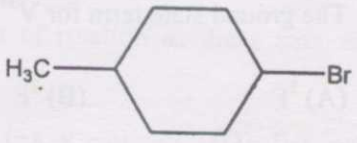
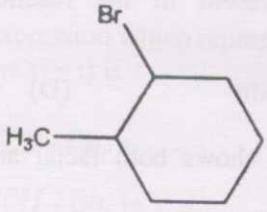
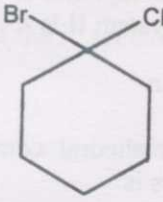


(C)



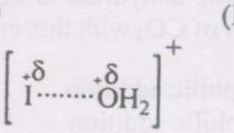
(D)

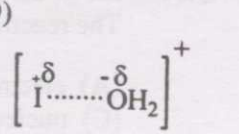


Q.4 Benzene can not be iodinated with I_2 directly. However, in presence of oxidants such as HNO_3, iodination is possible. The electrophile formed in this case is

(A) 

(B) 

(C) 

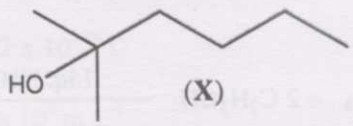
(D) 

Q.5 Classify the following species as electrophiles (E) and nucleophiles (N) in routine organic synthesis

SO_3 Cl^+ CH_3NH_2 H_3O^+ BH_3 CN^-

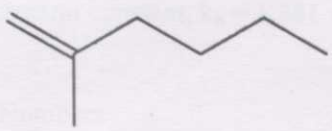
(A) E = SO_3, Cl^+, BH_3 ; N = CH_3NH_2, H_3O^+, CN^-
(B) E = Cl^+, H_3O^+ ; N = SO_3, CH_3NH_2, BH_3, CN^-
(C) E = Cl^+, H_3O^+, BH_3 ; N = SO_3, CH_3NH_2, H_3O^+, CN^-
(D) E = SO_3, Cl^+, H_3O^+, BH_3 ; N = CH_3NH_2, CN^-

Q.6 The major product obtained upon treatment of compound **X** with H_2SO_4 at 80°C is



(**X**)

(A)



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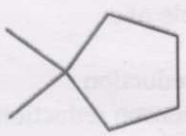
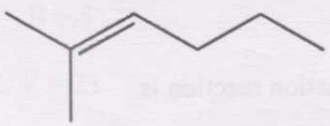


(C)



(D)

Q.7 $BaTi[Si_3O_9]$ is a class of

(A) ortho silicate (B) cyclic silicate (C) chain silicate (D) sheet silicate

Q.8 The ground state term for V^{3+} ion is

(A) ^3F (B) ^2F (C) ^3P (D) ^2D

Q.9 In photosynthesis, the predominant metal present in the reaction centre of photosystem II is

(A) Zn (B) Cu (C) Mn (D) Fe

Q.10 The octahedral complex / complex ion which shows both facial and meridianal isomers is

(A) Triglycinatocobalt(III)
(B) Tris(ethylenediamine)cobalt(III)
(C) Dichlorodiglycinatocobalt(III)
(D) Trioxalatocobaltate(III)

Q.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

(A) electrophilic addition
(B) electron transfer
(C) nucleophilic addition
(D) electrophilic substitution

Q.12 The difference in the measured and calculated magnetic moment (based on spin-orbit coupling) is observed for

(A) Pm^{3+} (B) Eu^{3+} (C) Dy^{3+} (D) Lu^{3+}

Q.13 For a redox reaction, $Cd^{2+} + 2e^- \rightleftharpoons Cd$, the $(E_p)_{anodic}$ observed in cyclic voltametry at hanging mercury drop electrode is –650 mV vs. SCE. The expected value for $(E_p)_{cathodic}$ is

(A) –708 mV (B) –679 mV (C) –650 mV (D) –621 mV

Q.14 The dimension of Planck constant is (M, L and T denote mass, length and time respectively)

(A) ML^3T^{-2} (B) ML^2T^{-1} (C) $M^2L^{-1}T^{-1}$ (D) $M^{-1}L^2T^{-2}$

Q.15 For a homonuclear diatomic molecule, the bonding molecular orbital is

(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

Q.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

(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 $\Delta J = -1$

Q.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

(A) (–x, –y, z) (B) (x, –y, –z) (C) (–x, y, –z) (D) (–x, –y, –z)

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

(A) $(\partial E / \partial n_i)_{s, v, n_j}$

(B) $(\partial H / \partial n_i)_{s, v, n_j}$

(C) $(\partial A / \partial n_i)_{s, v, n_j}$

(D) $(\partial G / \partial n_i)_{s, v, n_j}$

Q.19 Which of the following statements is **NOT** correct for a catalyst?

(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

Q.20 The value of the rate constant for the gas phase reaction $2NO_2 + F_2 \rightarrow 2NO_2F$ is 38 $dm^3\ mol^{-1}\ s^{-1}$ at 300K. The order of the reaction is

(A) 0 (B) 1 (C) 2 (D) 3

Q. 21 to Q. 75 carry two marks each.

Q.21 Boric acid in aqueous solution in presence of glycerol behaves as a strong acid due to the formation of

(A) an anionic metal-chelate
(B) borate anion
(C) glycerate ion
(D) a charge transfer complex

Q.22 Match the compounds in **List I** with the corresponding structure / property given in **List II**

List I	**List II**
(a) $(Ph_3P)_3RhCl$	(i) Spinel
(b) LiC_6	(ii) Intercalation
(c) PtF_6	(iii) Oxidising agent
(d) Ni_3S_4	(iv) Catalyst for alkene 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 – i	d- iv
(D)	a- iv	b – iii	c – ii	d- i

Q.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

(A) WMe_6 (B) $(CO)_5W\text{-}Me$
(C) $(CO)_5W{=}C(Me)OMe$ (D) $(CO)_5W \equiv CMe$

Q.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

(A) 3.0 and 3.0 (B) 3.0 and 3.5 (C) 3.5 and 3.5 (D) 3.5 and 3.0

Q.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?

(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

Q.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

(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+}

Q.27 Arrange the following metal complexes in order of their increasing hydration energy

$\underset{\mathbf{P}}{[Mn(H_2O)_6]^{2+}}$ $\underset{\mathbf{Q}}{[V(H_2O)_6]^{2+}}$ $\underset{\mathbf{R}}{[Ni(H_2O)_6]^{2+}}$ $\underset{\mathbf{S}}{[Ti(H_2O)_6]^{2+}}$

(A) P < S < Q < R (B) P < Q < R < S (C) Q < P < R < S (D) S < R < Q < P

Q.28 In the complex, $[Ni_2(\eta^5\text{-}Cp)_2(CO)_2]$, 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

(A) 16 e^-, bridging (B) 17e^-, bridging (C) 18 e^-, terminal (D) 18 e^-, bridging

Q.29 The correct classification of $[B_5H_5]^{2-}$, B_5H_9 and B_5H_{11} respectively is

(A) closo, arachno, nido
(B) arachno, closo, nido
(C) closo, nido, arachno
(D) nido, arachno, closo

Q.30 The compounds **X** and **Y** in the following reaction are

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

(A) X = $(Et)_2P(S)SH$; Y = $(Et)_2P(S)Cl$
(B) X = $(EtO)_2P(S)SH$; Y = $(EtO)_2P(S)Cl$
(C) X = $(EtO)_2PSH$; Y = $(EtO)_2PCl$
(D) X = $(Et)_3PO$; Y = $(Et)_3PCl$

Q.31 Consider the reactions

1. $[Cr(H_2O)_6]^{2+} + [CoCl(NH_3)_5]^{2+} \rightarrow [Co(NH_3)_5(H_2O)]^{2+} + [CrCl(H_2O)_5]^{2+}$
2. $[Fe(CN)_6]^{4-} + [Mo(CN)_8]^{3-} \rightarrow [Fe(CN)_6]^{3-} + [Mo(CN)_8]^{4-}$

Which one of the following is the correct statement?

(i) Both involve an inner sphere mechanism
(ii) Both involve an outer sphere mechanism
(iii) Reaction 1 follows inner sphere and reaction 2 follows outer sphere mechanism
(iv) Reaction 1 follows outer sphere and reaction 2 follows inner sphere mechanism

(A) i (B) ii (C) iv (D) iii

Q.32 The pair of compounds having the same hybridization for the central atom is

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

Q.33 In the reaction shown below, **X** and **Y** respectively are

$$Mn_2(CO)_{10} \xrightarrow{Na} (\mathbf{X}) \xrightarrow{CH_3COCl} (\mathbf{Y})$$

(A) $[Mn(CO)_4]^{2-}$, $[CH_3C(O)Mn(CO)_5]^-$ (B) $[Mn(CO)_5]^-$, $CH_3C(O)Mn(CO)_5$
(C) $[Mn(CO)_5]^-$, $ClMn(CO)_5$ (D) $[Mn(CO)_4]^{2-}$, $[ClMn(CO)_5]^-$

Q.34 The Lewis acid character of BF_3, BCl_3 and BBr_3 follows the order

(A) $BF_3 < BBr_3 < BCl_3$ (B) $BCl_3 < BBr_3 < BF_3$
(C) $BF_3 < BCl_3 < BBr_3$ (D) $BBr_3 < BCl_3 < BF_3$

Q.35 The compound which shows L←M charge transfer is

(A) $Ni(CO)_4$ (B) $K_2Cr_2O_7$ (C) HgO (D) $[Ni(H_2O)_6]^{2+}$

Q.36 The reaction of $[PtCl_4]^{2-}$ with NH_3 gives rise to

(A) $[PtCl_4(NH_3)_2]^{2-}$ (B) *trans*-$[PtCl_2(NH_3)_2]$
(C) $[PtCl_2(NH_3)_4]$ (D) *cis*-$[PtCl_2(NH_3)_2]$

Q.37 Zeise's salt is represented as

(A) H_2PtCl_6 (B) $[PtCl_4]^{2-}$
(C) $[ZnCl_4]^{2-}$ (D) $[PtCl_3(\eta^2\text{-}C_2H_4)]^-$

Q.38 The catalyst used in the conversion of ethylene to acetaldehyde using Wacker process is

(A) $HCo(CO)_4$ (B) $[PdCl_4]^{2-}$
(C) V_2O_5 (D) $TiCl_4$ in the presence of $Al(C_2H_5)_3$

Q.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 JK^{-1} mol^{-1}) is

(A) 4.5 kJ (B) 13.5 kJ (C) 9.0 kJ (D) 18.0 kJ

Q.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

(A) – 0.0075 (B) 0.0075 (C) 0.075 (D) – 0.075

Q.41 Given that $E_o(Fe^{3+}, Fe)$= –0.04 V and $E_o(Fe^{2+}, Fe)$ = –0.44 V, the value of $E_o(Fe^{3+}, Fe^{2+})$ is

(A) 0.76 V (B) – 0.40 V (C) – 0.76 V (D) 0.40 V

Q.42 For the reaction P + Q + R → S, experimental data for the measured initial rates is given below

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^{-5}
2	0.4	0.5	0.4	3.2×10^{-4}
3	0.4	2.0	0.4	1.28×10^{-3}
4	0.1	0.25	1.6	4.0×10^{-5}

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

Q.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

(A) 56.8 min. (B) 170.4 min. (C) 85.2 min. (D) 227.2 min.

Q.44 The reaction

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

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) $2k_b [NO] [O_2]$
(B) $(2k_ak_b[NO]^2[O_2]) / (k_a + k_b[O_2])$
(C) $2k_b [NO]^2 [O_2]$
(D) $k_a[NO]^2[O_2]$

Q.45 40 millimoles of NaOH are added to 100 mL of a 1.2 M HA andY 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

(A) 5.30 (B) 5.00 (C) 0.30 (D) 10.30

Q.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

(A) 115.3 JK^{-1} (B) 5.8 JK^{-1} (C) 382.9 JK^{-1} (D) 230.6 JK^{-1}

Q.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

(A) 46.0 eV (B) 11.5 eV (C) 5.1 eV (D) 2.9 eV

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

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

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

(A) 0 (B) $P/(2\pi)$ (C) $P/(4\pi)$ (D) $Pm^2/(4\pi^2)$

Q.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 $\rightarrow$ B is spontaneous when $\Delta H = 18.83$ kJ mol^{-1} and $\Delta S = 41.84$ 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.

(A) only i (B) only ii (C) both i and iii (D) both ii and iv

Q.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

(A) 3/8 (B) 3/4 (C) 1/2 (D) 2/3

Q.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

(A) 1000 (B) 1503 (C) 2354 (D) 2987

Q.52 The $J = 0 \rightarrow 1$ rotational transition for $^{1}H^{79}Br$ occurs at 500.72 GHz. Assuming the molecule to be a rigid rotor, the $J = 3 \rightarrow 4$ transition occurs at

(A) 50.1 cm^{-1} (B) 66.8 cm^{-1} (C) 16.7 cm^{-1} (D) 83.5 cm^{-1}

Q.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?

(A) $\frac{k_1(T_2)}{k_1(T_1)} = \frac{k_2(T_2)}{k_2(T_1)}$ (B) $\frac{k_1(T_2)}{k_1(T_1)} > \frac{k_2(T_2)}{k_2(T_1)}$

(C) $\frac{k_1(T_2)}{k_1(T_1)} \geq \frac{k_2(T_2)}{k_2(T_1)}$ (D) $\frac{k_1(T_2)}{k_1(T_1)} < \frac{k_2(T_2)}{k_2(T_1)}$

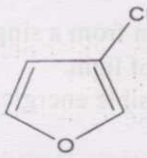
Q.54 The number of degrees of freedom for a system consisting of NaCl(s), Na^{+}(aq) and Cl^{-}(aq) at equilibrium is

(A) 2 (B) 3 (C) 4 (D) 5

Q.55 Match the structures in **List I** with their correct names given in **List II**

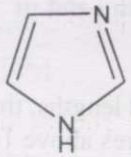
List I **List II**

(a)



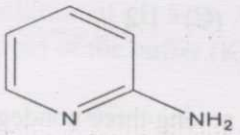
(i) 2-methyl furan

(b)



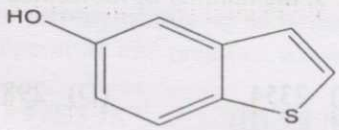
(ii) Imidazole

(c)



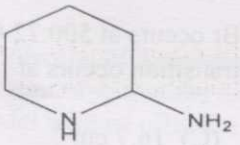
(iii) 5-hydroxybenzothiazole

(d)



(iv) 2-amino piperidine

(e)



(v) 2-amino morpholine

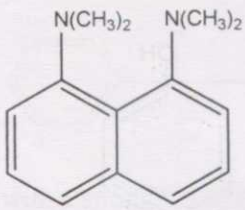
(vi) 2-amino azine
(vii) 3-methyl furan
(viii) 4-hydroxybenzothiazole

(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

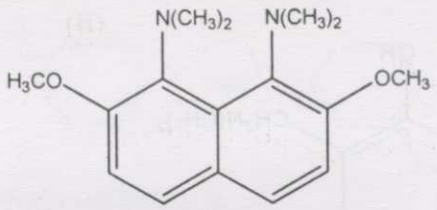
Q.56 The result of the reduction of either (R) or (S) 2-methylcyclohexanone, in separate reactions, using $LiAlH_4$ is that the reduction of

(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

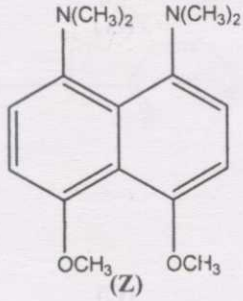
Q.57 The increasing order of basicity among the following is



(X)



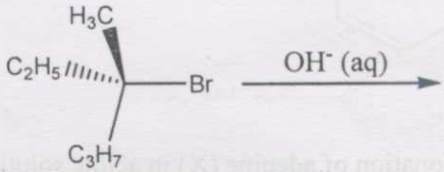
(Y)



(Z)

(A) Y<X<Z (B) Y<Z<X (C) X<Z<Y (D) X<Y<Z

Q.58 In the reaction



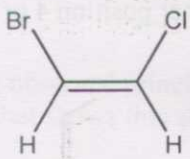
if the concentration of both the reactants is doubled, then the rate of the reaction will

(A) remain unchanged
(B) quadruple
(C) reduce to one fourth
(D) double

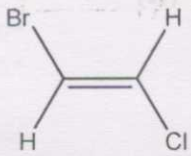
Q.59 Match the structures in **List I** with the coupling constant [^{1}H J (Hz)] given in **List II**

List I

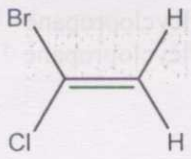
(a)



(b)



(c)



List II

(i) ~ 1 Hz

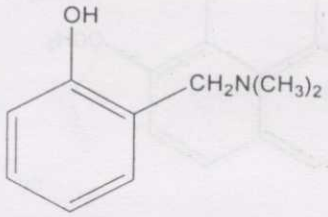
(ii) ~ 10 Hz

(iii) ~ 15 Hz

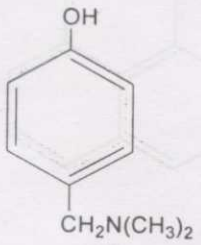
(A) a-i b-ii c-iii (B) a-ii b-iii c-i
(C) a-iii b-ii c-i (D) a-iii b-i c-ii

Q.60 Phenol on reaction with formaldehyde and dimethyl amine mainly gives

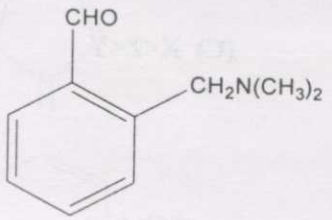
(A)



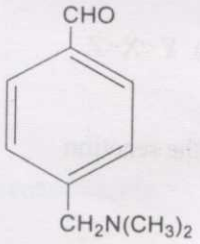
(B)



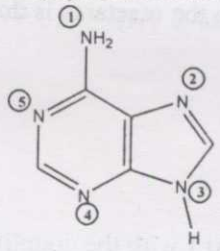
(C)



(D)



Q.61 The mono protonation of adenine (X) in acidic solution

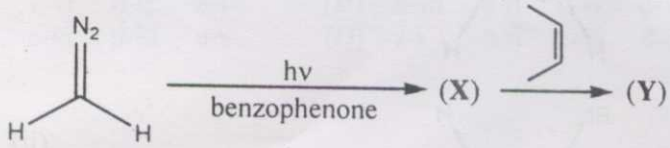


(X)

mainly occurs at

(A) position 1
(B) position 2
(C) position 3
(D) either position 4 or 5

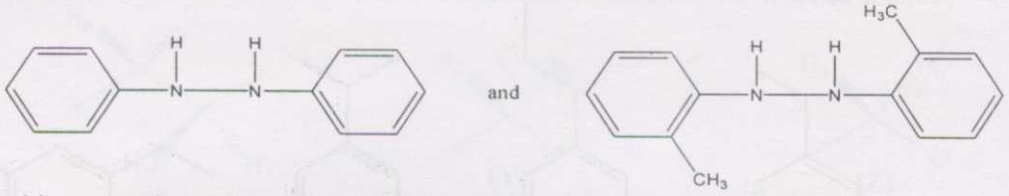
Q.62 In the following reaction



(**X**) and (**Y**) respectively are

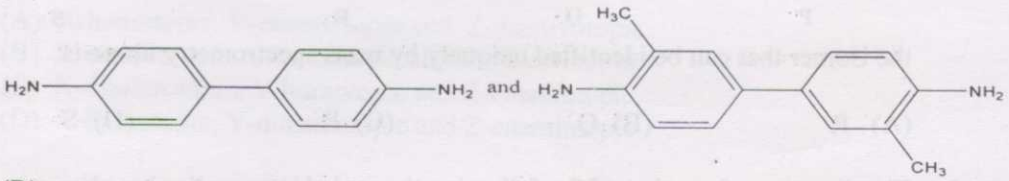
(A) ^{1}:CH_2 and cis 1,2 dimethylcyclopropane
(B) ^{3}:CH_2 and cis 1,2 dimethylcyclopropane
(C) ^{1}:CH_2 and a mixture of cis / trans 1,2 dimethylcyclopropane
(D) ^{3}:CH_2 and a mixture of cis / trans 1,2 dimethylcyclopropane

Q.63 The major products obtained upon treating a mixture of

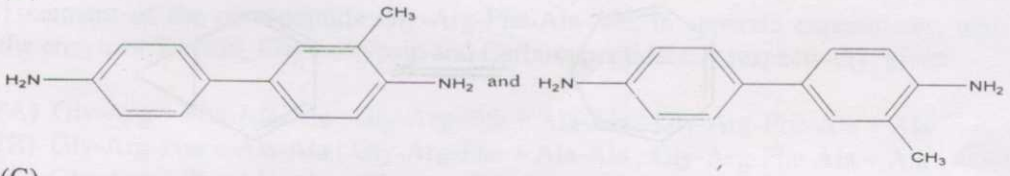


with a strongly acidic solution of H_2SO_4 is

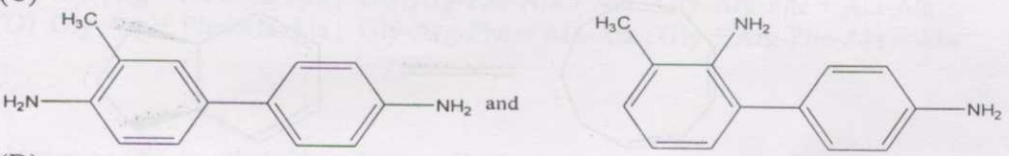
(A)



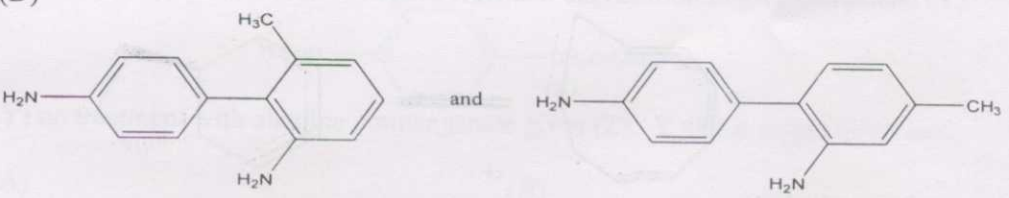
(B)



(C)



(D)

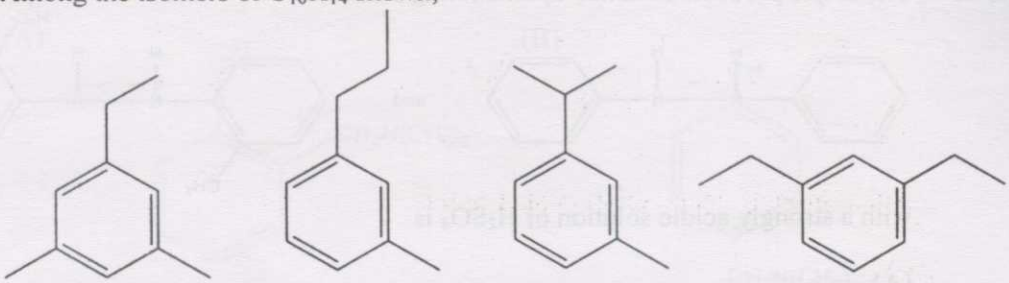


Q.64 Match the observed principal absorbtions in the visible spectrum shown in **List I** with the bond that shows this absorbtion in **List II**

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

Q.65 Among the isomers of $C_{10}H_{14}$ shown,

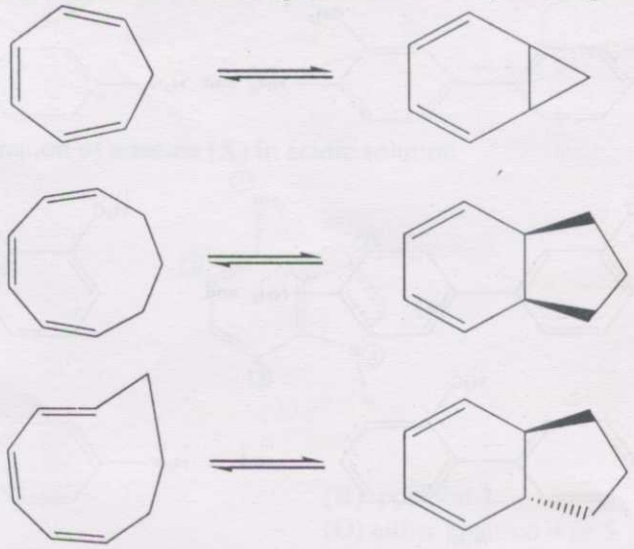


P Q R S

the isomer that can be identified uniquely by mass spectrometry **alone** is

(A) P (B) Q (C) R (D) S

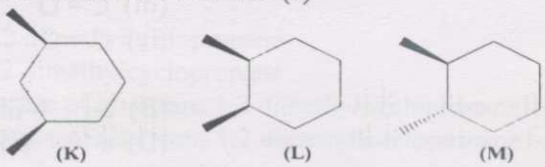
Q.66 The direction of rotation of the following thermal electrocyclic ring closures



respectively is

(A) disrotatory, disrotatory, disrotatory
(B) conrotatory, conrotatory, conrotatory
(C) disrotatory, disrotatory, conrotatory
(D) disrotatory, conrotatory, disrotatory

Q.67 The molecule(s) that exist as *meso* structure(s)

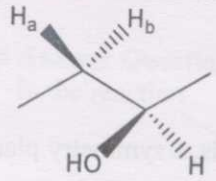


(K) (L) (M)

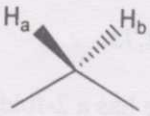
is / are

(A) only M (B) both K and L (C) only L (D) only K

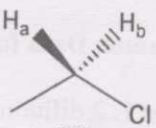
Q.68 The stereochemical descriptors for the atoms labeled H_a and H_b in the structures



(X)



(Y)



(Z)

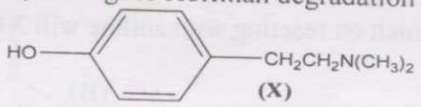
respectively are

(A) X-homotopic, Y-enantiotopic and Z-diasterotopic
(B) X-enantiotopic, Y-homotopic and Z-diasterotopic
(C) X-diasterotopic, Y-homotopic and Z-enantiotopic
(D) X-homotopic, Y-diasterotopic and Z-enantiotopic

Q.69 Treatment of the pentapeptide Gly-Arg-Phe-Ala-Ala, in separate experiments, with the enzymes Trypsin, Chymotrypsin and Carboxypeptidase A respectively, gives

(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

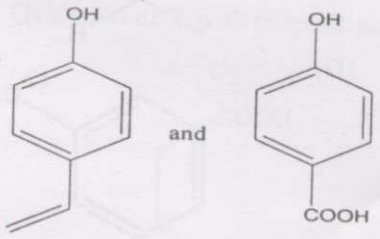
Q.70 Hordenine (**X**), an alkaloid, undergoes Hoffman degradation to give compound (**Y**).



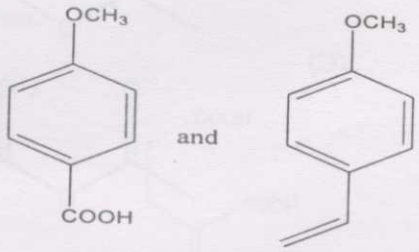
(X)

(**Y**) on treatment with alkaline permanganate gives (**Z**). **Y** and **Z** respectively are

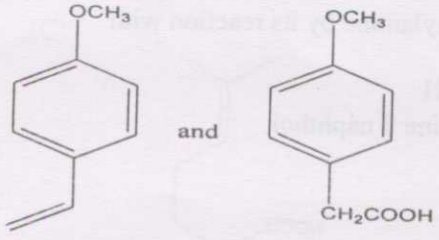
(A)



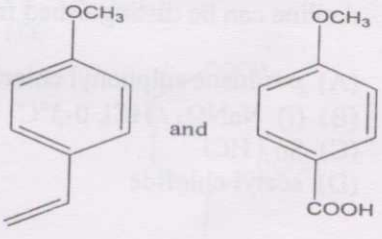
(B)



(C)



(D)



Common Data Questions

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.

Q.71 The number of distinct symmetry operations that can be performed on the molecule is

(A) 2 (B) 4 (C) 6 (D) 8

Q.72 The number of irreducible representations of the point group of the molecule is

(A) 1 (B) 2 (C) 3 (D) 4

Q.73 When two H atoms of the above molecule are also replaced by F atoms, the point group of the resultant molecule will be

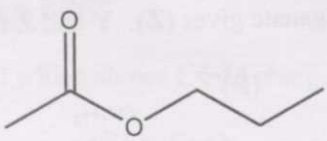
(A) C_i (B) C_{2h} (C) C_{2v} (D) D_{2h}

Common Data for Questions 74, 75:

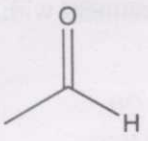
Reactivity of aryl amines towards electrophilic aromatic substitution is much higher than that of aliphatic amines. Hence differential reactivity of the amino group is desirable in many reactions.

Q.74 The compound which on reacting with aniline will **NOT** form an acetanilide is

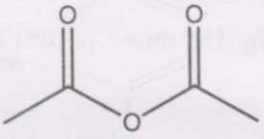
(A)



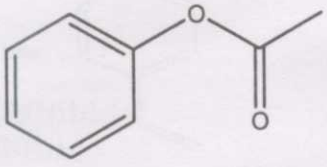
(B)



(C)



(D)



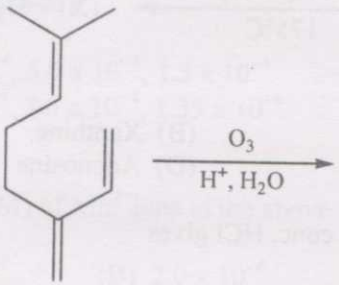
Q.75 Aniline can be distinguished from methylamine by its reaction with

(A) *p*-toluene sulphonyl 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.85 carry two marks each.

Linked Answer Questions 76 & 77:

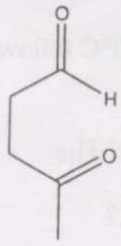
Q.76 In the reaction



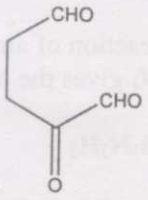
(X) + Acetone + 2 Formaldehyde

Compound **X** is

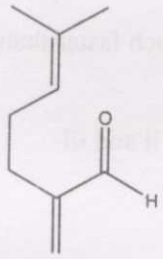
(A)



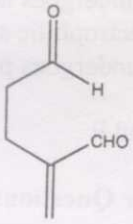
(B)



(C)

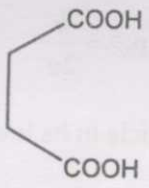


(D)

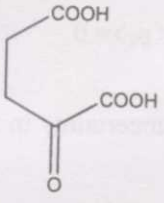


Q.77 Oxidation of **X** with chromic acid chiefly gives

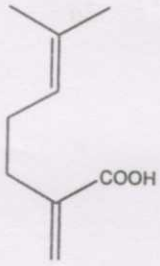
(A)



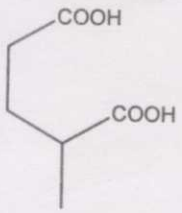
(B)



(C)



(D)



Linked Answer Questions 78 & 79:

Q.78 In the reaction

$$\text{AMP} \xrightarrow[175°C]{\text{aq. } NH_3} (\mathbf{X}) + H_3PO_4$$

Compound **X** is

(A) Adenine
(B) Xanthine
(C) 2, 6 - diaminopurine
(D) Adenosine

Q.79 Compound **X** on treatment with conc. HCl gives

(A) Uric acid (B) Adenine (C) Hypoxanthine (D) Guanine

Linked Answer Questions 80 & 81:

Q.80 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

(A) $B_3N_3H_3$ (B) $B_3N_3H_6$ (C) $B_3N_3H_{12}$ (D) $[BH\text{-}NH]_n$

Q.81 Which of the following statement(s) is/are true for **X**?
(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.

(A) i and ii (B) only ii (C) ii and iii (D) i and iv

Linked Answer Questions 82 & 83:

Q.82 Consider a particle of mass m moving in a one-dimensional box under the potential V=0 for $0 \le x \le a$ 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

(A) $\langle p_x \rangle = 0$ (B) $\langle p_x \rangle = \frac{h}{a}$ (C) $\langle p_x \rangle = \frac{h}{2a}$ (D) $\langle p_x \rangle = \frac{h}{2\pi a}$

Q.83 The uncertainty in the momentum (Δp_x) of the particle in its lowest energy state is

(A) $\Delta p_x = 0$ (B) $\Delta p_x = \frac{h}{a}$ (C) $\Delta p_x = \frac{h}{2a}$ (D) $\Delta p_x = \frac{h}{2\pi a}$

Linked Answer Questions 84 & 85:

Q.84 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

(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}

Q.85 The activity (M) of Mn^{2+} ions in the above solution is

(A) 1.0×10^{-4} (B) 2.0×10^{-4} (C) 3.0×10^{-4} (D) 4.0×10^{-4}

END OF THE QUESTION PAPER