IIT-JAM: 2018

Chemistry

1. Section-A contains 30 Multiple Choice Questions (MCQ). Each question has 4 choices (a), (b), (c) and (d), for its answer, out of which ONLY ONE is correct. Form Q.1 to Q.10 carries 1 Marks and Q.11 to Q.30 carries 2 Marks each.

2. Section-B contains 10 Multiple Select Questions (MSQ). Each question has 4 choices (a), (b), (c) and (d), for its answer, out of which ONE or MORE than ONE is/are correct. For each correct answer you will be awarded 2 Marks.

3. Section-C contains 20 Numerical Answer Type (NAT) questions. Form Q.41 to Q.50 carries 1 Marks each and Q.51 to Q.60 carries 2 Marks each. For each NAT type question, the value of answer in between 0 to 9.

4. In all sections, questions not attempted will result in zero mark. In Section-A (MCQ), wrong will be deducted for each wrong answer. For all 1 marks questions, 1/3 marks will be deducted for each wrong answer. For all 2 marks questions, 2/3 marks will be deducted for each wrong answer. In Section-B (MSQ), there is no negative and no partial marking provisions. There is no negative marking in Section-C (NAT) as well.

❖ Question Paper

Section-A: MCQ

Q.1 – Q.10 carry one mark each

Q.1 On hydrolysis, aluminium carbide produces

(a) CH_4 (b) C_2H_6 (c) C_2H_4 (d) C_2H_2

Q.2 Carbonic anhydrase is an example of

(a) Hydrolysis enzyme (b) Redox enzyme

(c) O_2 transport protein (d) Heme-protein

Q.3 The correct order of melting points of group 15 trifluorides is

(a) $PF_3 < AsF_3 < SbF_3 < BiF_3$ (b) $BiF_3 < SbF_3 < PF_3 < AsF_3$

(c) $PF_3 < SbF_3 < AsF_3 < BiF_3$ (d) $BiF_3 < AsF_3 < SbF_3 < PF_3$

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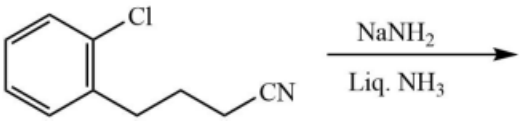
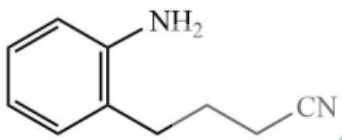
Q.4 NaF, KF, MgO and CaO are crystalline solids. They have NaCl structure. Their lattice energies vary in the order

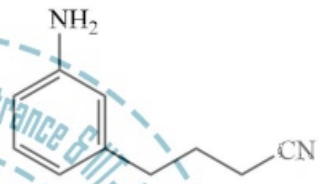
(a) NaF < KF < MgO < CaO (b) KF < NaF < CaO < MgO

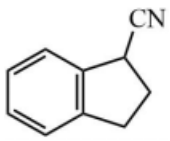
(c) MgO < CaO < NaF < KF (d) CaO < MgO < KF < NaF

Q.5 The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d)

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Q.6 The compound that contains the most acidic hydrogen is

(a) $H_2C = CH_2$ (b) $HC \equiv CH$ (c) $H_2C = C = CH_2$ (d) $H_3C - CH_3$

Q.7 The C-2 epimer of glucose is

(a) D-Mannose (b) D-Fructose (c) D-Galactose (d) D-Galose

Q.8 The values of integral $\int_{-2}^{+2} xe^{-2x^2}\,dx$ is

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

Q.9 The number of crystal systems and the number of Bravais lattices are, respectively

(a) 14 and 7 (b) 7 and 32 (c) 32 and 14 (d) 7 and 14

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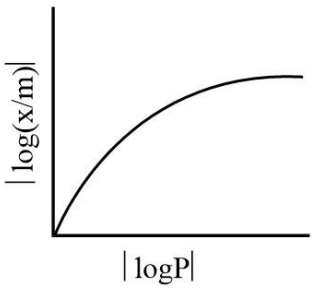
Q.10 For adsorption of a gas on a solid surface, the plot that represents Freundlich isotherm is (x = mass of a gas, M = mass of adsorbent, P = pressure)

(a)



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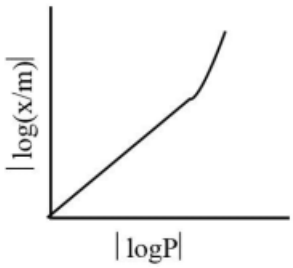

(c)

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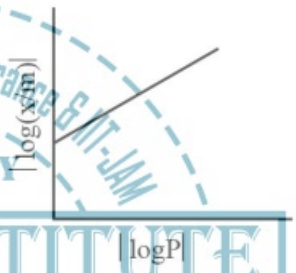

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Q.11 –Q.30 carry TWO marks each

Q.11 with respect to periodic properties, the correct statement is

(a) Electron affinity order is F > O > Cl

(b) First ionisation energy order is Al > Mg > K

(c) Atomic radius order is N > P > As

(d) Ionic radius order is $K^+ > Ca^{2+} > Mg^{2+}$

Q.12 Which plot represents a spectrophotometric titration, where the titrant alone absorbs, light in the visible region?

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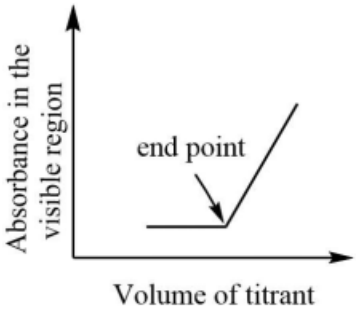
(a)



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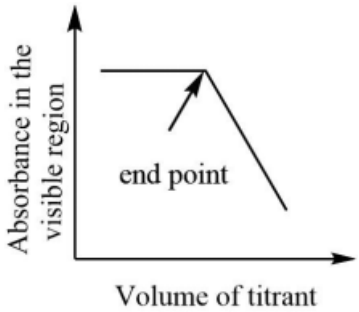

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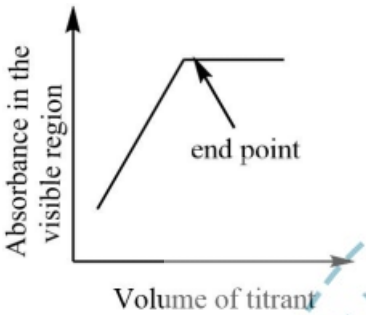

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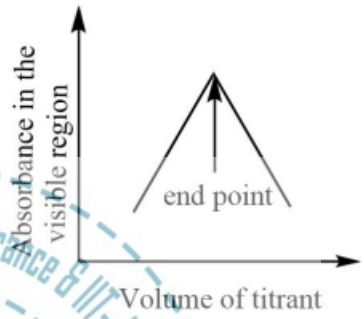

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Q.13 Among the following metal carbonyl species, the one with the highest metal-carbon back bonding is

(a) $[Ti(CO)_7]^{2-}$ (b) $[V(CO)_6]^-$ (c) $Cr(CO)_6$ (d) $[Mn(CO)_6]^-$

Q.14 The correct order of Δ_0 (the octahedral crystal field splitting of d- orbitals) values for the following anionic metal complexes is

(a) $[Ir(CN)_6]^{3-} < [Rh(CN)_6]^{3-} < [RhI_6]^{3-} < [CoI_6]^{3-}$ (b) $[CoI_6]^{3-} < [RhI_6]^{3-} < [Rh(CN)_6]^{3-} < [Ir(CN)_6]^{3-}$

(c) $[CoI_6]^{3-} < [Rh(CN)_6]^{3-} < [RhI_6]^{3-} < [Ir(CN)_6]^{3-}$ (d) $[Ir(CN)_6]^{3-} < [CoI_6]^{3-} < [Rh(CN)_6]^{3-} < [RhI_6]^{3-}$

Q.15 The decay modes of ^{14}C and ^{14}O are

(a) β^- decay

(b) Positron emission

(c) β^- decay and positron emission, respectively

(d) Positron emission and β^- decay, respectively

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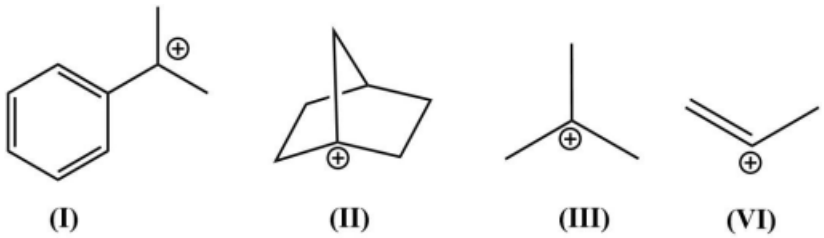
Q.16 Consider the following four Xenon compounds: XeF_2, XeF_4, XeF_4 and XeO_3. The pair of xenon compounds expected to have non-zero diploe moment is

(a) XeF_4 and XeF_6 (b) XeF_2 and XeF_4 (c) XeF_2 and XeO_3 (d) XeF_6 and XeO_3

Q.17 The correct order of stability for the following carbocations is



(I) **(II)** **(III)** **(VI)**

(a) I < III < IV < II (b) III < II < IV < I (C) II < IV < III < I (d) IV < III < I < II

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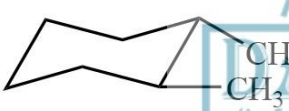
Q.18 Among the dimethylcyclohexanes which one can be obtained in enantiopure form?

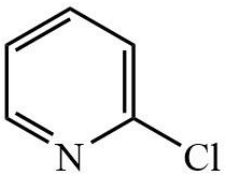
(a) 

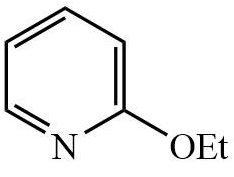
(b)

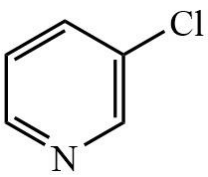
(c)

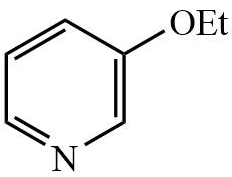
(d)

Q.19 The major product formed in the following reaction is

(a) 

(b) 

(c) 

(d) 

Q.20 The product (X) formed in the following reaction sequence is

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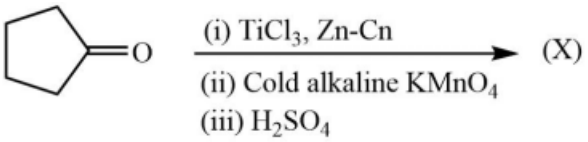
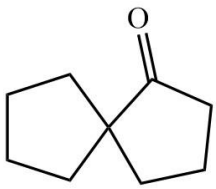
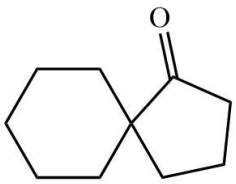
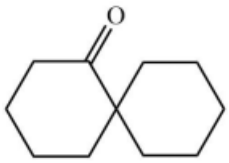
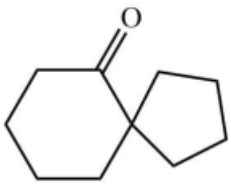


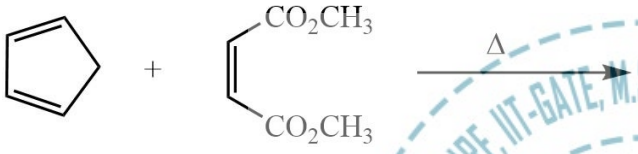
(a) 

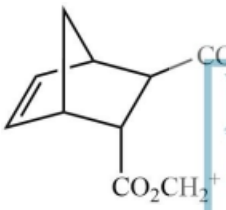
(b) 

(c) 

(d) 

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



(a) 

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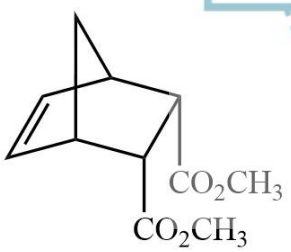
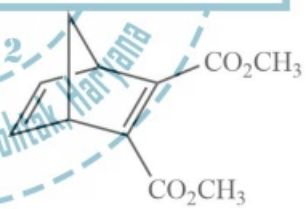
(c) 

(d) 

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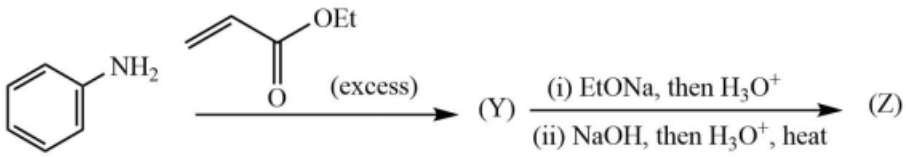
Q.22 The major products Y and Z in the following reaction sequence are



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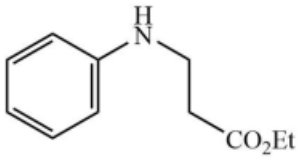
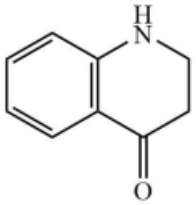
(a)

(Y) = 

(Z) = 

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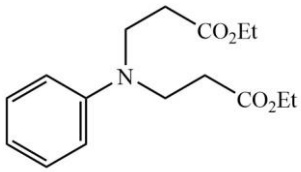
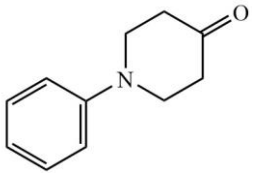
(Y) = 

(Z) = 

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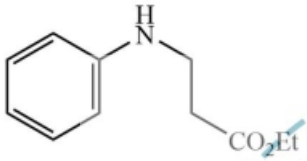
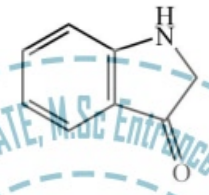
(Y) = 

(Z) = 

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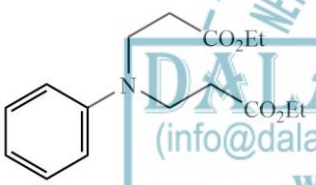
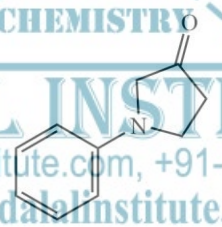
(Y) = 

(Z) = 

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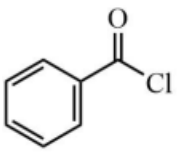
Q.23 The correct order of carbonyl stretching frequencies for the following compounds is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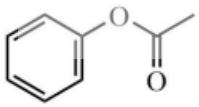
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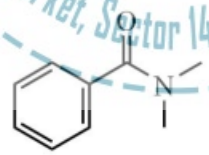
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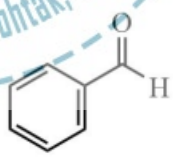
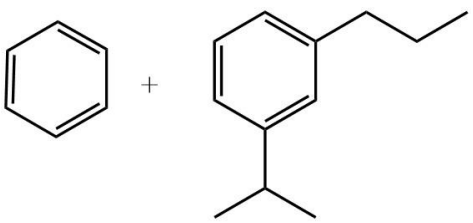

(IV)

(a) II < I < III < IV (b) I < III < II < IV (c) IV < II < III < I (d) III < IV < II < I

Q.24 The sequence of three steps involved in the following conversion is



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(a) (i) Friedel-Crafts alkylation; (ii) Reduction; (iii) Friedel-Crafts acylation

(b) (i) Friedel-Crafts acylation ; (ii) Friedel-Crafts alkylation; (iii) Reduction

(c) (i) Friedel-Crafts acylation; (ii)Friedel-Crafts alkylation; (iii) Reduction

(d) (i) Friedel-Crafts alkylation; (ii) Reduction; (iii) Friedel-Crafts acylation

Q.25 The correct expression that corresponds to reversible and adiabatic expansion of an ideal gas is

(a) $\Delta U = 0$ (b) $\Delta H = 0$ (c) $\Delta S = 0$ (d) $\Delta G = 0$

Q.26 The ionic AB_2 ionise in water as

$$AB_2 \rightleftharpoons A^{2+} + 2B^-$$

The mean ionic activity co-efficient (γ_z)

(a) $\gamma_{A^{2+}}^{\frac{1}{2}}\gamma_{B^-}$ (b) $\gamma_{A^{2+}}^{\frac{1}{2}}\gamma_{B^-}^{\frac{3}{2}}$ (c) $\gamma_{A^{2+}}^{\frac{2}{3}}\gamma_{B^-}^{\frac{1}{3}}$ (d) $(\gamma_{A^{2+}} + 2\gamma_{B^-})^{1/2}$

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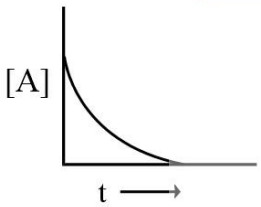
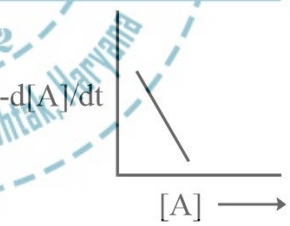
Q.27 The reaction A → products, follows first-order kinetics. If [A] represents the concentration of reactant at time t, the incorrect variation is the shown in

(a)



(b)



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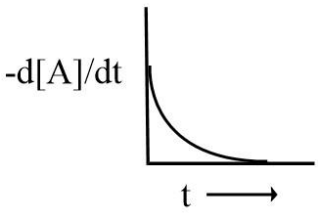
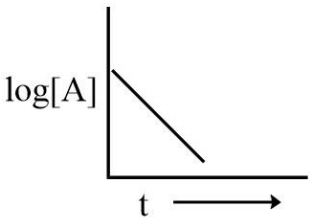


(d)



Q.28 The behaviour of Cl_2 is closest to ideal gas behaviour at

(a) 100°C and 10.0 atm (b) 0°C and 0.50 atm

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(c) 200°C and 0.50 atm (d) –100°C and 10.0 atm

Q.29 A vector $\vec{A}$ =is rotated through an angle and is also doubled in magnitude resulting in . an acceptable value of x is

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

Q.30 With reference to the variation of molar conductivity(Λ_m) with concentration for a strong electrolyte in an aqueous solution, the correct statement is

(a) The asymmetry effect contributes to decrease Λ_m whereas the electrophoretic effect contribute to increase Λ_m

(b) The asymmetry effect contributes to increase Λ_m whereas the electrophoretic effect contribute to decrease Λ_m

(c) Both asymmetry effect and electrophoretic effect contribute to decrease Λ_m

(d) Both asymmetry effect and electrophoretic effect contribute to increase Λ_m

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SECTION-B: Multiple Select Questions (MSQ)

Q.31 Which of the following metal(s) is(are) extracted from its(their) sulphide ore(s) by self-reduction/ air reduction method?

(a) Cu (b) Al (c) Au (d) Pb

Q.32 In a saturated calomel electrode, the saturation is with respect to

(a) KCl (b) Hg_2Cl_2 (c) $HgCl_2$ (d) AgCl

Q.33 Consider the following six solid binary oxides CaO, Al_2O_3, PbO, Cs_2O, SiO_2 and Sb_2O_3. The pair(s)of ionic oxides is(are)

(a) CaO and Al_2O_5 (b) CaO and PbO

(c) Cs_2O and Al_2O_5 (d) SiO_2 and Sb_2O_3

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Q.34 Choose the correct answer(s) with respect to the magnesium-EDTA titration carried out in the pH range 7-10.5, using Solochrome black as indicator

(a) Magnesium-indicator complex is more stable than the magnesium-EDTA complex

(b) At the end point, the colour of the solution is due to the indicator

(c) After the end point, the colour of the solution is due to the indicator

(d) pH range of 7-10.5 is necessary for the specific colour change

Q.35 One reaction with $NaNO_2$ and HCl, which of the following amino alcohol(s) will yield compound P?

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Q.36 The correct statement(s) about carbene is/are

(a) Carbene is a neutral species.

(b) Carbene is an intermediate in the Curtius-rearrangement.

(c) Carbene can insert into both σ and π-bonds

(d) Carbene is generated from amines on the reaction with nitrous acid.

Q.37 The compound(s) that show(s) positive haloform test is(are)

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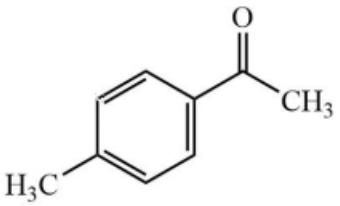
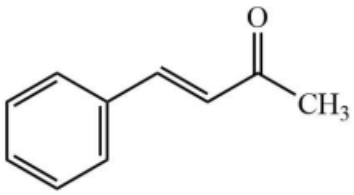
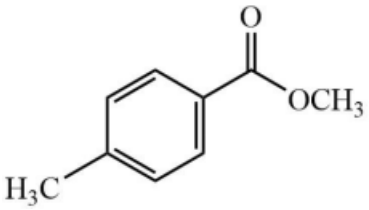
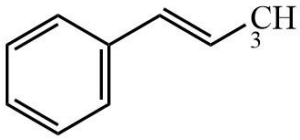
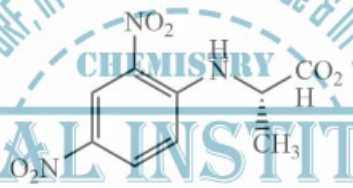
(a) 

(b) 

(c) 

(d) 

Q.38 Tetrapeptide(s) that give(s) the following product on reaction with Sanger's reagent followed by hydrolysis is(are)



(a) Ala-Gly-Leu-Phe (b) Asp-Phe-Leu-Pro (c) Asp-Gly-Tyr-Phe (d) Ala-Phe-Tyr-Pro

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Q.39 Which of the following set(s) of quantum numbers is(are) NOT allowed?

(a) $n = 3, l = 2, m_l = -1$ (b) $n = 4, l = 0, m_l = -1$

(c) $n = 3, l = 3, m_l = -3$ (d) $n = 5, l = 3, m_l = +2$

Q.40 The correct expression(s) for isothermal expansion of 1 mole of an ideal gas is(are)

(a) $\Delta A = RTln\frac{V_{initial}}{V_{final}}$ (b) $\Delta G = RTln\frac{V_{initial}}{V_{final}}$ (c) $\Delta H = RTln\frac{V_{finial}}{V_{initial}}$ (d) $\Delta S = RTln\frac{V_{final}}{V_{initial}}$

Section-C: Numerical Answer Type (NAT)

Q.41 – Q.50 carry ONE mark each.

Q.41 The number of possible isomer for [Pt(py)(NH_3)BrCl] is ……(py is pyridine)

Q.42 The volume of 0.3M ferrous ammonium sulphate solution required for the completion of redox titration with 20 mL of 0.1 M potassium dichromate solution is …….. mL

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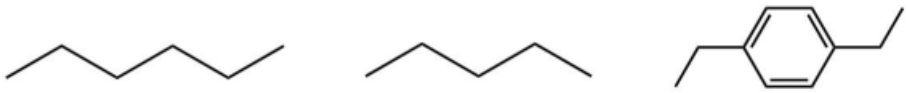
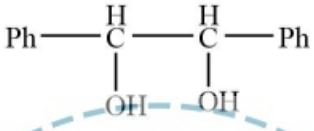
Q.43 Among the following hydrocarbon(s), how many of them would give rise to three groups of proton NMR peaks with 2:2:3 integration ratio?



Q.44 The number of stereoisomers possible for the following compounds is…….



Q.45 The number of hydrogen bond(s) present in a guanine-cytosine base pair is…….

Q.46 The time for 50% completion of a zero order reaction is 30 min. Time for 80% completion of this reaction is …….. min.

Q.47 Consider the reaction, $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$

The value of ΔU for the reaction at 300 K is –281.8 kJ mol^{-1}. The value of ΔH at some temperature is …… kJ mol^{-1} (rounded up to the first decimal place)

(R = 8.314 J K^{-1} mol^{-1})

Q.48 The nuclear spin quantum number (I) of a nucleus is 3/2. When placed in an external magnetic field, the number of possible spin energy states it can occupy is ……..

Q.49 The value of C_v for 1 mole of N_2 gas predicted from the principle of equipartition of energy, ignoring vibrational contribution, is ……JK^{-1} mol^{-1}(rounded up to the two decimal place)

Q.50 Assuming ideal gas behaviour, the density of O_2 gas at 300 K and 1.0 atm is ……gL^{-1}(rounded up to two decimal places).

Q.51 – Q.60 carry TWO mark each.

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Q.51 How many of the following interhalogen species have 2 lone pairs of electrons on the central atom?

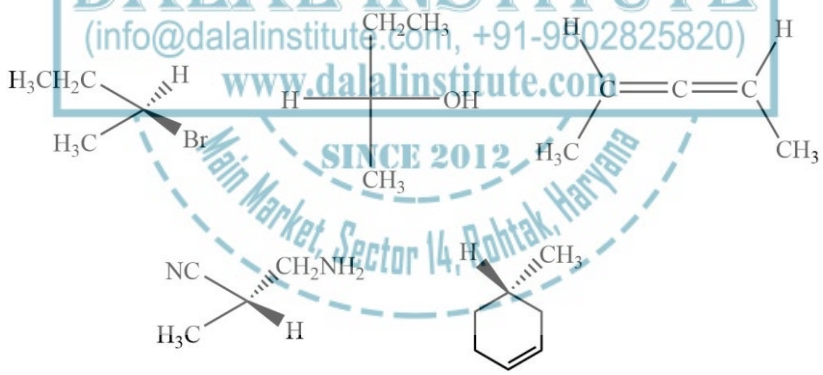
ClF_3, ClF_2^- , ClF_5, and ICl_2^+

Q.52 ^{24}Na decays to one-fourth of its initial amount in 29.8 hours. Its decay constant is C: 39.9% and H: 6.7%. If the molecule weight of the compound is 180, the number of carbon atoms present in the molecule is……

Q.53 The magnitude of crystal field stabilization energy (CFSE) of octahedral $[Ti(H_2O)_6]^{3+}$ complex is 7680 cm^{-1} . The wavelength at the maximum absorption (λ_{max}) of this complex is ……. nm (rounded up to nearest integer)

Q.54 Elemental analysis of an organic compound containing C, H and O gives percentage composition: C: 39.9 % and H: 6.7 %. If the molecular weight of the compound is 180, the number of carbon atoms present in the molecule is_____.

Q.55 The number of compounds having S-configuration among the following is …….



Q.56 The emf of a standard cadmium cell is 1.02 V at 300K. The temperature coefficient of the cell is -5.0×10^{-3} VK^{-1}. The value of $\Delta H^0$for the cell is……. kJ mol^{-1}(rounded up to two decimal places)

[1F=96500 C mol^{-1}]

Q.57 For the reaction $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$, the following information is given T = 300K

$\Delta\bar{H}^0 = -285$ kJ mol^{-1} $\quad\quad$ $\bar{s}^0_{H_2O}(\ell) = 70$ JK^{-1} mol^{-1}

$\bar{s}^0_{O_2}(\ell) = 204$ JK^{-1} mol^{-1} $\quad\quad$ $\bar{s}^0_{H_2}(\ell) = 130$ JK^{-1} mol^{-1}

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$\Delta\bar{s}^0_{universe}$ for the reaction is ……JK^{-1} mol^{-1}.

Q.58 For H_2 molecule, the fundamental vibrational frequency($\tilde{\nu}_e$) in wave numbers can be taken as 4400 cm^{-1}. The zero-point energy of the molecule is ……. kJ mol^{-1}(rounded up to the two decimal places) [h = 6.6 × 10^{-1} Js, c = 3×10^8 ms^{-1}, N_A = 6×10^{23} mol^{-1}]

Q.59 The solubility of PbI_2 in 0.10 M KI(aq) is ……. × 10^{-7} M (rounded up to two decimal places) [The solubility product K_{sp} = 7.1× 10^{-9}]

Q.60 The electron of a hydrogen atom is in its nth Bohr orbit having de-Broglie wavelength of 13.4Å. The value of n is……. (rounded up to nearest integer) [Radius of nth Bohr orbit = 0.53 n^2 Å, π=3.14]

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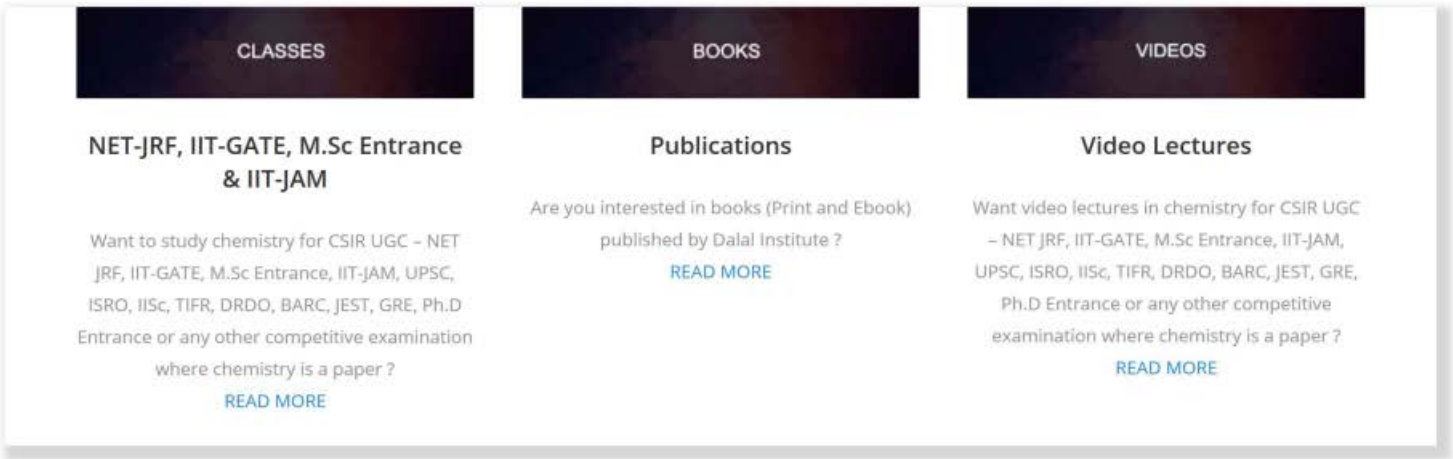

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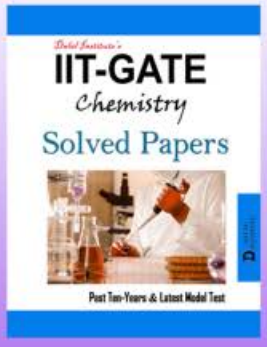

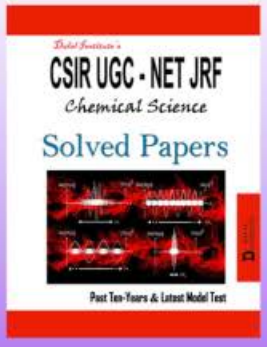

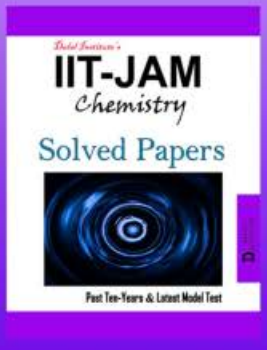

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