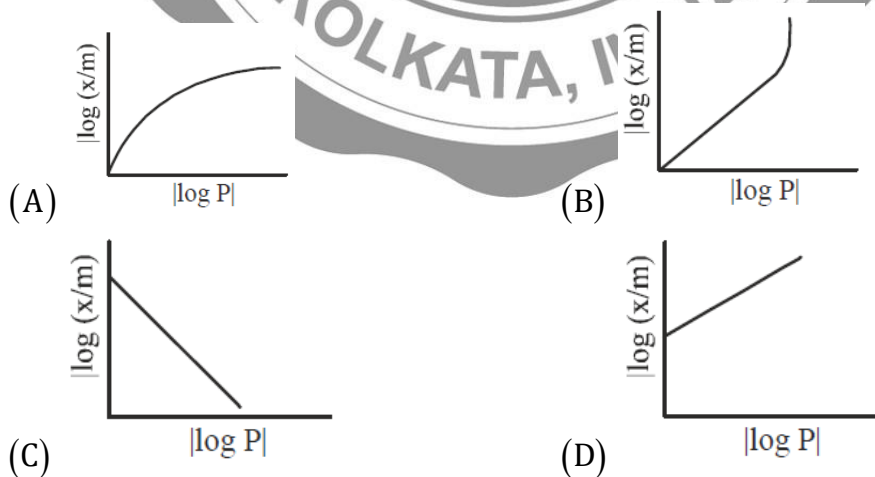




IIT JAM 2018

SECTION - I

1. NaF, KF, MgO and CaO are crystalline solids. They have NaCl structure. Their lattice energies vary in the order
(A) $\text{NaF} < \text{KF} < \text{MgO} < \text{CaO}$ (B) $\text{KF} < \text{NaF} < \text{CaO} < \text{MgO}$
(C) $\text{MgO} < \text{CaO} < \text{NaF} < \text{KF}$ (D) $\text{CaO} < \text{MgO} < \text{KF} < \text{NaF}$
2. The number of crystal system and the number of Bravais lattices are, respectively,
(A) 14 and 7 (B) 7 and 32 (C) 32 and 14 (D) 7 and 14
3. The value of integral $\int_{-2}^{+2} x e^{-2x^2} dx$ is
(A) 0 (B) $\frac{1}{2}$ (C) 1 (D) 2
4. Carbonic anhydrase is an example of
(A) Hydrolysis enzyme (B) Redox enzyme
(C) O_2 transport protein (D) Heme protein
5. For adsorption of a gas on a solid surface, the plot that represents Freundlich isotherm is (x = mass of gas, m = mass of adsorbent, P = pressure)

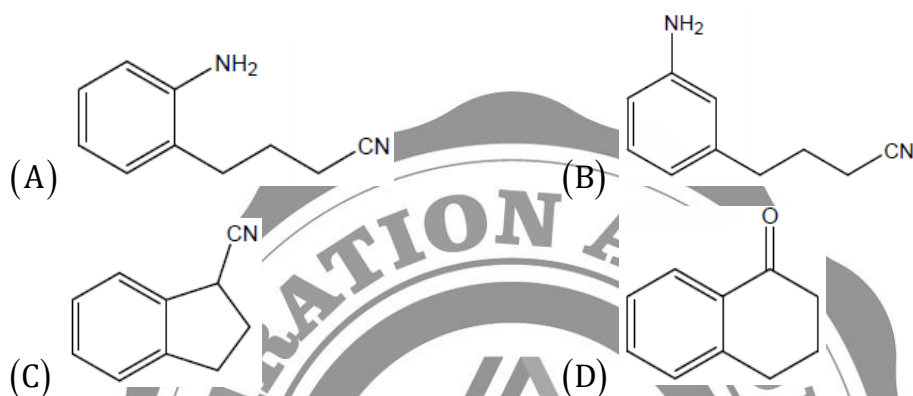
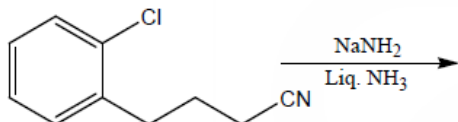


6. The compound that contains the most acidic hydrogen is



- (A) $\text{H}_2\text{C} = \text{CH}_2$ (B) $\text{CH} \equiv \text{CH}$ (C) $\text{H}_2\text{C} = \text{C} = \text{CH}_2$ (D) $\text{H}_3\text{C} - \text{CH}_3$

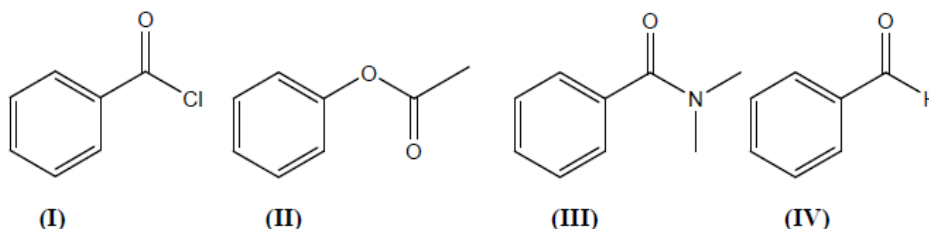
7. The major product formed in the following reaction is



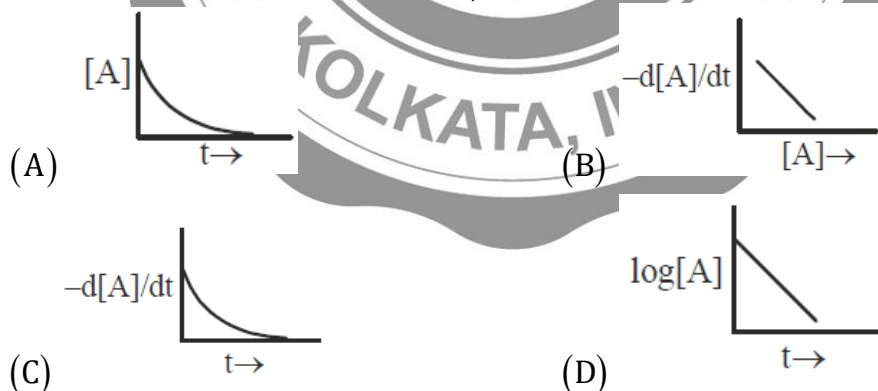
8. The CORRECT order of melting points of group 15 trifluorides is
(A) $\text{PF}_3 < \text{AsF}_3 < \text{SbF}_3 < \text{BiF}_3$ (B) $\text{BiF}_3 < \text{SbF}_3 < \text{PF}_3 < \text{AsF}_3$
(C) $\text{PF}_3 < \text{SbF}_3 < \text{AsF}_3 < \text{BiF}_3$ (D) $\text{BiF}_3 < \text{AsF}_3 < \text{SbF}_3 < \text{PF}_3$
9. The C-2 epimer of D-glucose is
(A) D-Mannose (B) D-Fructose (C) D-Galactose (D) D-Gulose
10. On hydrolysis, aluminium carbide produces
(A) CH_4 (B) C_2H_6 (C) C_2H_4 (D) C_2H_2
11. With respect to periodic properties, the CORRECT statement is
(A) Electron affinity order is $\text{F} > \text{O} > \text{Cl}$
(B) First ionisation energy order is $\text{Al} > \text{Mg} > \text{K}$
(C) Atomic radius order is $\text{N} > \text{P} > \text{As}$
(D) Ionic radius order is $\text{K}^+ > \text{Ca}^{2+} > \text{Mg}^{2+}$
12. Among the following metal carbonyl species, the one with the highest metal-carbon back bonding is
(A) $[\text{Ti}(\text{CO})_6]^{2-}$ (B) $[\text{V}(\text{CO})_6]^-$ (C) $\text{Cr}(\text{CO})_6$ (D) $[\text{Mn}(\text{CO})_6]^+$

13. 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 contributes to increase Λ_m
- (B) The asymmetry effect contributes to increase Λ_m whereas the electrophoretic effect contributes 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

14. The CORRECT order of carbonyl stretching frequencies for the following compound is



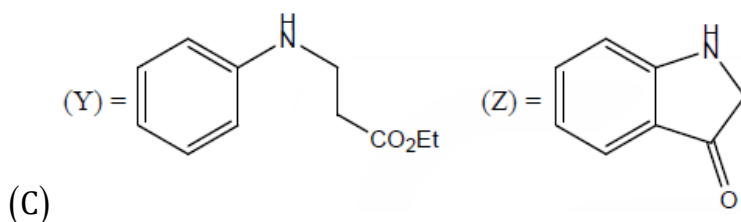
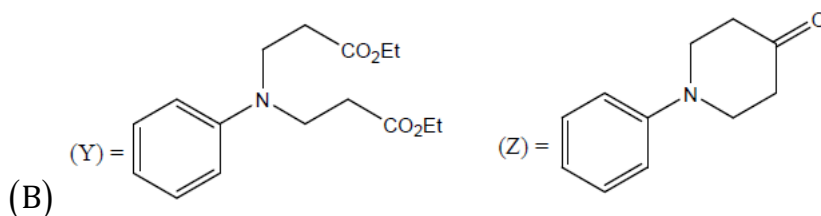
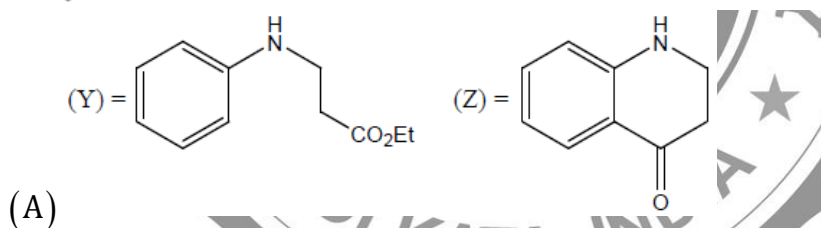
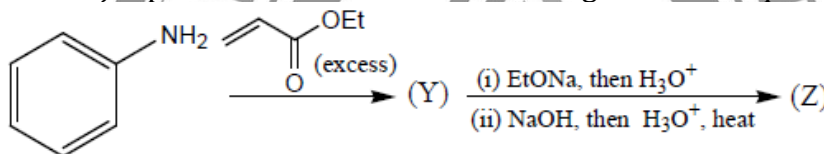
- (A) II < I < III < IV (B) I < III < II < IV (C) IV < II < III < I (D) III < IV < II < I
15. The reaction, $A \rightarrow \text{Products}$, follows first-order kinetics. If $[A]$ represents the concentration of reactant at time t , the INCORRECT variation is shown in

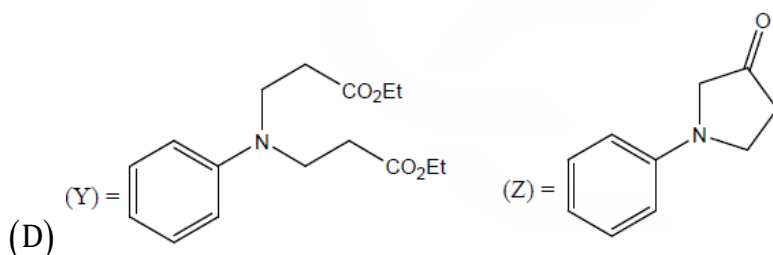


16. The behaviour of Cl_2 is closest to ideal gas behaviour at
- (A) 100°C and 10.0 atm (B) 0°C and 0.50 atm
- (C) 200°C and 0.50 atm (D) -100°C and 10.0 atm

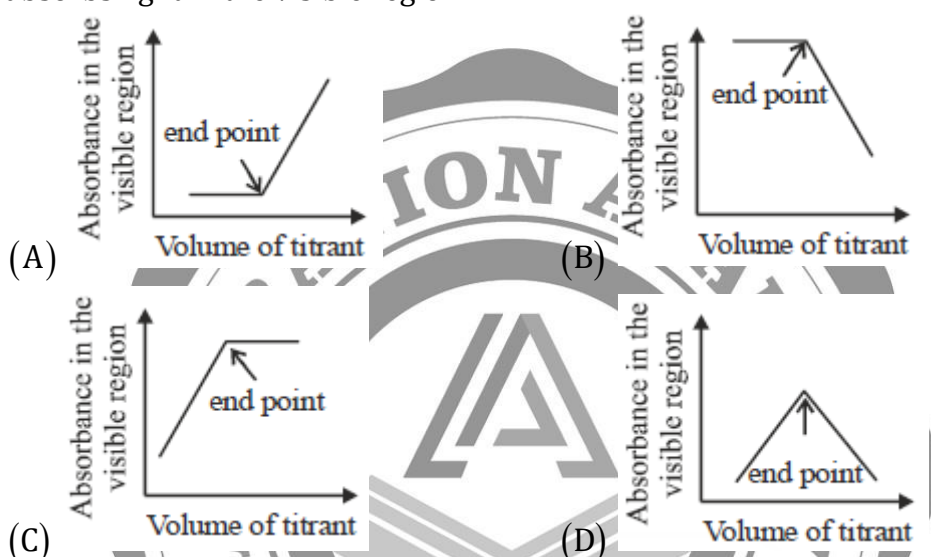


17. The decay modes of ^{14}C and ^{14}O are
(A) β^- decay
(B) Positron emission
(C) β^- decay and positron emission, respectively
(D) Positron emission and β^- decay, respectively
18. A vector $\vec{A} = \vec{i} + x\vec{j} + 3\vec{k}$ is rotated through an angle and is also doubled in magnitude resulting in $\vec{B} = 4\vec{i} + (4x-2)\vec{j} + 2\vec{k}$. An acceptable value of x is
(A) 1 (B) 2 (C) 3 (D) $\frac{4}{3}$
19. 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) $\Delta G = 0$
20. The major products Y and Z in the following reaction sequence are

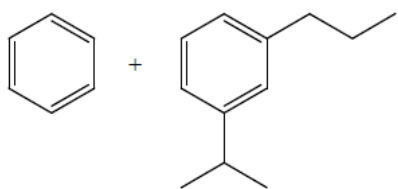




21. Which plot represents a spectrophotometric titration, where the titrant alone absorbs light in the visible region?



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

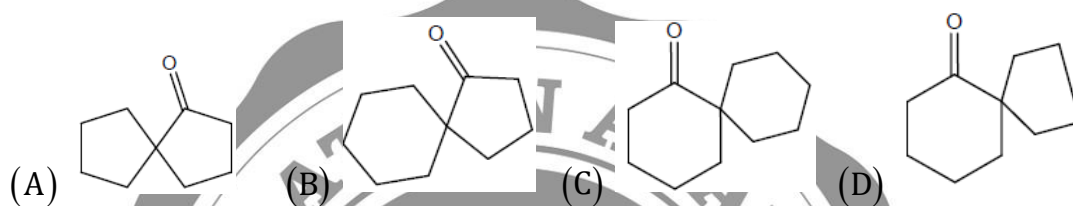
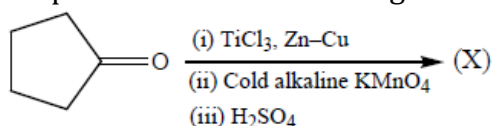


- (A) (i) Friedel-Crafts alkylation; (ii) Reduction; (iii) Friedel-Crafts acylation
 (B) (i) Friedel-Crafts acylation; (ii) Friedel-Crafts alkylation; (iii) Reduction
 (C) (i) Friedel-Crafts acylation; (ii) Reduction; (iii) Friedel-Crafts alkylation
 (D) (i) Friedel-Crafts alkylation; (ii) Friedel-Crafts acylation; (iii) Reduction
23. The electrolyte AB_2 ; ionises in water as $AB_2 \rightleftharpoons A^{2+} + 2B^-$; The mean ionic activity coefficient (γ_{\pm})

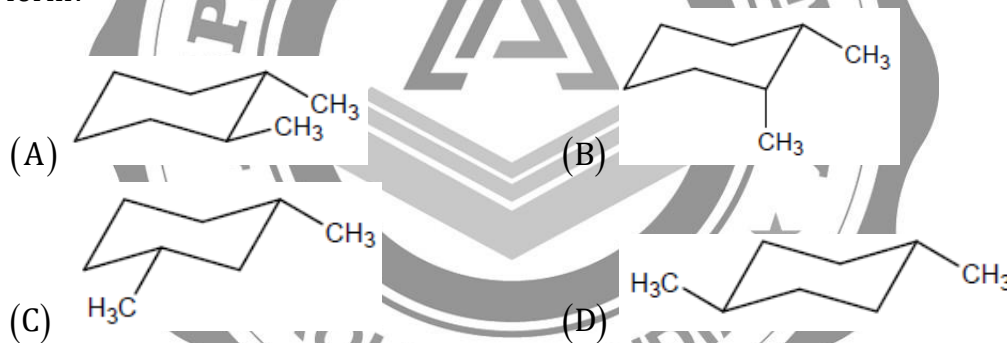
(A) $\gamma_{A^{2+}}^{\frac{1}{2}} \gamma_{B^-}$ (B) $\gamma_{A^{2+}}^{\frac{1}{2}} \gamma_{B^-}^{\frac{2}{3}}$ (C) $\gamma_{A^{2+}}^{\frac{2}{3}} \gamma_{B^-}^{\frac{1}{3}}$ (D) $(\gamma_{A^{2+}} + 2\gamma_{B^-})^{\frac{1}{2}}$

24. Consider the following four xenon compounds: XeF_2 , XeF_4 , XeF_6 and XeO_3 . The pair of xenon compounds expected to have non-zero dipole 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

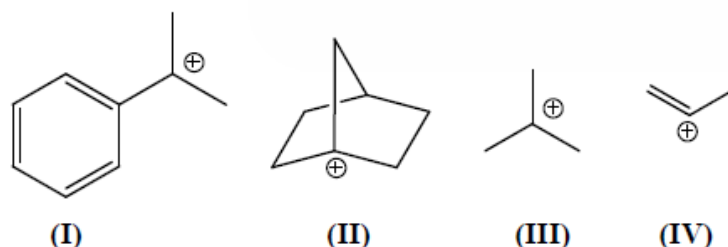
25. The product X in the following reaction sequence is



26. Among the dimethyl-cyclohexanes, which one can be obtained in enantiopure form?

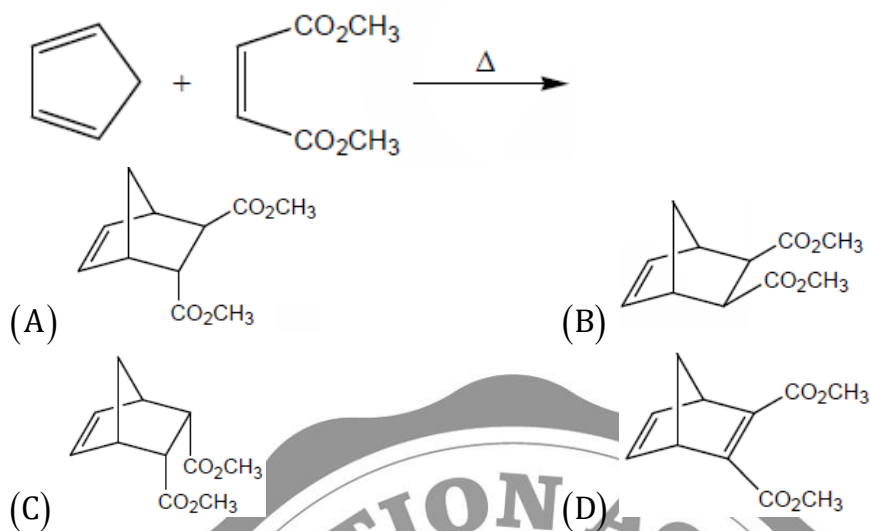


27. The correct order of stability for the following carbocation is

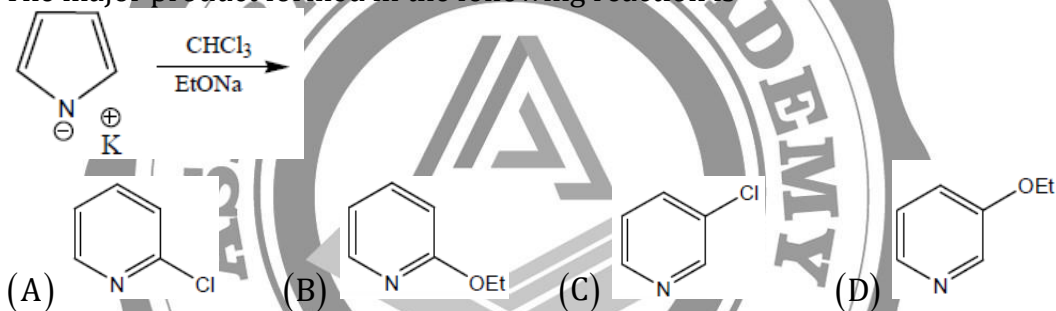


- (A) I < III < IV < II (B) III < II < IV < I (C) II < IV < III < I (D) IV < III < I < II

28. The major product formed in the following reaction is



29. The major product formed in the following reaction is



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

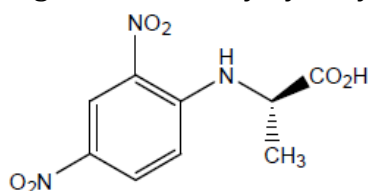
- (A) $[\text{Ir}(\text{CN})_6]^{3-} < [\text{Rh}(\text{CN})_6]^{3-} < [\text{RhI}_6]^{3-} < [\text{CoI}_6]^{3-}$
 (B) $[\text{CoI}_6]^{3-} < [\text{RhI}_6]^{3-} < [\text{Rh}(\text{CN})_6]^{3-} < [\text{Ir}(\text{CN})_6]^{3-}$
 (C) $[\text{CoI}_6]^{3-} < [\text{Rh}(\text{CN})_6]^{3-} < [\text{RhI}_6]^{3-} < [\text{Ir}(\text{CN})_6]^{3-}$
 (D) $[\text{Ir}(\text{CN})_6]^{3-} < [\text{CoI}_6]^{3-} < [\text{Rh}(\text{CN})_6]^{3-} < [\text{RhI}_6]^{3-}$

SECTION - II

1. 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)



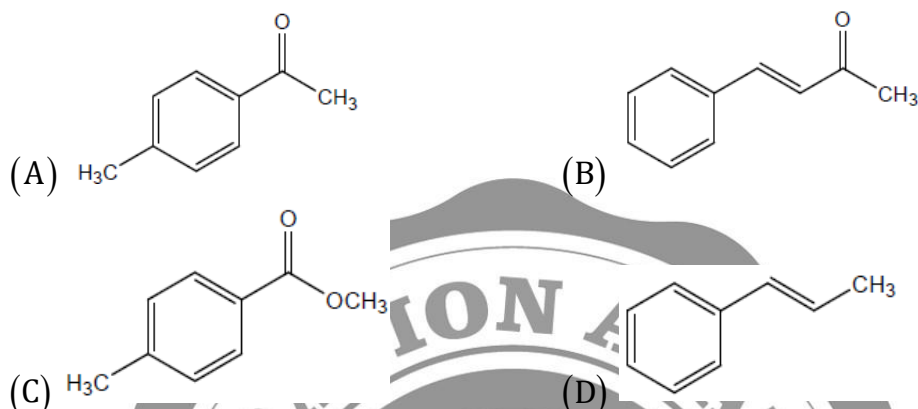
- (A) CaO and Al₂O₃ (B) CaO and PbO (C) Cs₂O and Al₂O₃ (D) SiO₂ and Sb₂O₅
2. Which of the following metal(s) is (are) extracted from its (their) sulphide ore(s) by self-reduction air reduction method?
(A) Cu (B) Al (C) Au (D) Pb
3. The correct statement(s) about carbene is(are)
(A) Carbene is a neutral 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 reaction with nitrous acid
4. 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 changes from red to blue
(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 observing the specific colour change
5. The correct expression(s) for isothermal expansion of 1 mol of an ideal gas is (are)
(A) $\Delta A = RT \ln \frac{V_{\text{initial}}}{V_{\text{final}}}$ (B) $\Delta G = RT \ln \frac{V_{\text{initial}}}{V_{\text{final}}}$
(C) $\Delta H = RT \ln \frac{V_{\text{final}}}{V_{\text{initial}}}$ (D) $\Delta S = R \ln \frac{V_{\text{final}}}{V_{\text{initial}}}$
6. Tetrapeptide(s) that gives (give) 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-Try-Pro

7. The compound(s) that shows (show) positive haloform test is (are)



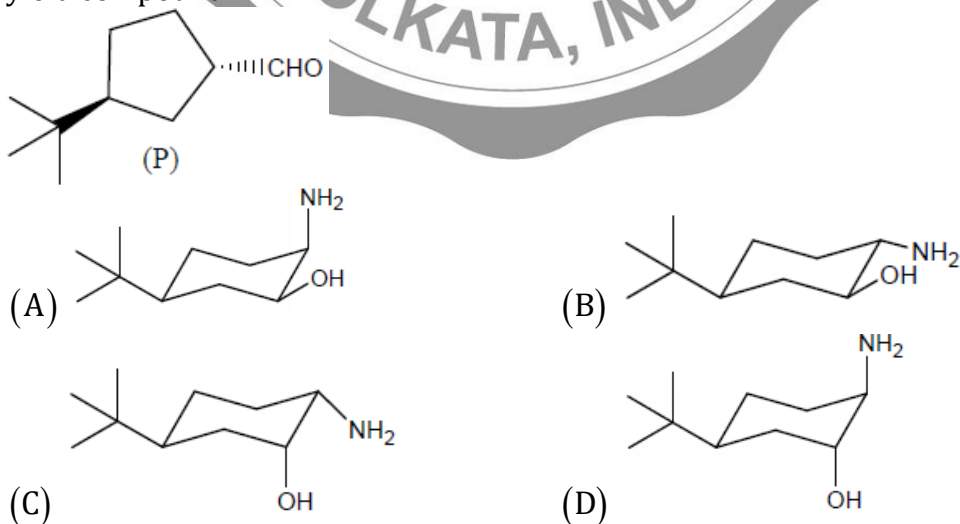
8. Which of the following set(s) of quantum numbers is (are) NOT allowed?

- (A) $n=3, l=2, m_1=-1$
(B) $n=4, l=0, m_1=-1$
(C) $n=3, l=3, m_1=-3$
(D) $n=5, l=3, m_1=+2$

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

- (A) KCl
(B) Hg_2Cl_2
(C) HgCl₂
(D) AgCl

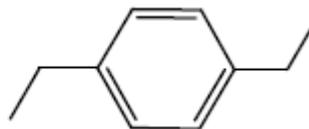
10. On reaction with NaNO_2 and HCl, which of the following amino alcohol(s) will yield compound P?





SECTION - III

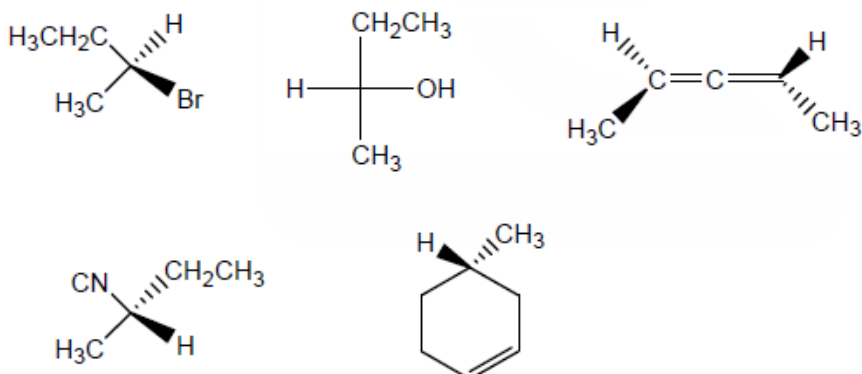
1. Among the following hydrocarbon(s), how many of them would give rise to three groups of proton NMR peaks with 2:2:3 integration ratio?



2. The nuclear spin quantum number (I) of a nucleus is $\frac{3}{2}$. When placed in an external magnetic field, the number of possible spin energy states it can occupy is _____.
3. The number of possible isomers for $[\text{Pt}(\text{py})(\text{NH}_3)\text{BrCl}]$ is _____ (py is pyridine)
4. The number of stereoisomers possible for the following compound is _____.
-
5. Assuming ideal gas behaviour, the density of O_2 gas at 300 K and 1.0 atm is _____ g L^{-1} (rounded up to two decimal places).
[$R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$, molar mass of $\text{O}_2 = 32$]
6. The time for 50% completion of a zero order reaction is 30 min. Time for 80% completion of this reaction is _____ min.
7. The volume of 0.3 M ferrous ammonium sulphate solution required for the completion of redox titration with 20 mL of 0.1 M potassium dichromate solution is _____ mL.
8. The value of C_v for 1 mol of N_2 gas predicted from the principle of equipartition of energy, ignoring vibrational contribution, is _____ $\text{J K}^{-1} \text{ mol}^{-1}$ (rounded up to two decimal places).
[$R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$]



9. The number of hydrogen bond(s) present in a guanine-cytosine base pair is _____.
10. Consider the reaction $\text{CO(g)} + \frac{1}{2}\text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)}$.
The value of ΔU for the reaction at 300 K is $-281.8 \text{ kJ mol}^{-1}$. The value of ΔH at same temperature is _____ kJ mol^{-1} (rounded up to the first decimal place).
[$R = 8.3 \text{ J K}^{-1}\text{mol}^{-1}$]
11. For the reaction $\text{H}_2\text{(g)} + \frac{1}{2}\text{O}_2\text{(g)} \rightarrow \text{H}_2\text{O(l)}$, the following information is given
 $T = 300 \text{ K}$
 $\Delta \bar{H}^\circ = -285 \text{ kJ mol}^{-1}$ $\bar{S}_{\text{H}_2\text{O}}^\circ(\text{l}) = 70 \text{ J K}^{-1}\text{mol}^{-1}$
 $\bar{S}_{\text{O}_2}^\circ(\text{g}) = 204 \text{ J K}^{-1}\text{mol}^{-1}$ $\bar{S}_{\text{H}_2}^\circ(\text{g}) = 130 \text{ J K}^{-1}\text{mol}^{-1}$
 $\bar{S}_{\text{universe}}^\circ$ for the reaction is _____ $\text{J K}^{-1}\text{mol}^{-1}$
12. How many of the following inter-halogen species have 2 lone pairs of electrons on the central atom?
 ClF_3 , ClF_2 , ClF_5 and ICl_2^+
13. The solubility of PbI_2 in 0.10 M KI(aq) is _____ $\times 10^{-7} \text{ M}$
(rounded up to two decimal places).
[The solubility product, $K_{\text{sp}} = 7.1 \times 10^{-9}$]
14. The number of compounds having s-configuration among the following is _____.



15. The magnitude of crystal field stabilization energy (CFSE) of octahedral $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ complex is 7680 cm^{-1} . The wavelength at the maximum absorption (λ_{max}) of this complex is _____ nm (rounded up to the nearest integer).
16. The electron of a hydrogen atom is in its n^{th} Bohr orbit having de Broglie wavelength of 13.4 \AA . The value of n is _____ (rounded up to the nearest integer).
[Radius of n^{th} Bohr orbit = $0.53 \cdot n^2 \text{ \AA}$, $\pi = 3.14$]
17. 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 _____.
18. The emf of a standard cadmium cell is 1.02 V at 300 K. The temperature coefficient of the cell is $-5.0 \times 10^{-5} \text{ VK}^{-1}$. The value of ΔH° for the cell is _____ kJ mol^{-1} (rounded up to two decimal places).
[$1 \text{ F} = 96500 \text{ C mol}^{-1}$]
19. For H_2 molecule, the fundamental vibrational frequency ($\bar{\nu}_e$) in wavenumbers can be taken as 400 cm^{-1} , the zero-point energy of the molecule is _____ kJ mol^{-1} (rounded up to two decimal places).
[$h = 6.6 \times 10^{-34} \text{ Js}$, $c = 3 \times 10^8 \text{ ms}^{-1}$, $N_A = 6 \times 10^{23} \text{ mol}^{-1}$]



20. ^{24}Na decays to one-fourth of its initial amount in 29.8 hours. Its decay constant is _____ hour^{-1} (rounded up to four decimal places).

