

Subject : CHEMISTRY

4031400725

(Booklet Number)



Duration : 90 Minutes

No. of Questions : 50

Full Marks : 100

INSTRUCTIONS

1. All questions are of objective type having four answer options for each. Only one option is correct. Correct answer will carry full marks 2. In case of incorrect answer or any combination of more than one answer, $\frac{1}{2}$ mark will be deducted.
2. Questions must be answered on OMR sheet by darkening the appropriate bubble marked A, B, C or D.
3. Use only **Black/Blue ink ball point pen** to mark the answer by complete filling up of the respective bubbles.
4. Mark the answers only in the space provided. Do not make any stray mark on the OMR Sheet.
5. Write question booklet number and your roll number carefully in the specified locations of the **OMR Sheet**. Also fill appropriate bubbles.
6. Write your name (in block letter), name of the examination centre and put your signature (as is appeared in Admit Card) in appropriate boxes in the OMR Sheet.
7. The OMR Sheet is liable to become invalid if there is any mistake in filling the correct bubbles for question booklet number/roll number or if there is any discrepancy in the name/signature of the candidate, name of the examination centre. The OMR Sheet may also become invalid due to folding or putting stray marks on it or any damage to it. The consequence of such invalidation due to incorrect marking or careless handling by the candidate will be sole responsibility of candidate.
8. Candidates are not allowed to carry any written or printed material, calculator, pen, docu- pen, log table, wristwatch, any communication device like mobile phones, bluetooth devices etc. inside the examination hall. Any candidate found with such prohibited items will be **reported against** and his/her candidature will be summarily cancelled.
9. Rough work must be done on the question booklet itself. Additional blank pages are given in the question booklet for rough work.
10. Hand over the OMR Sheet to the invigilator before leaving the Examination Hall.
11. Candidates are allowed to take the Question Booklet after examination is over.

Signature of the Candidate : _____
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Chemistry



Chemistry



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SPACE FOR ROUGH WORK

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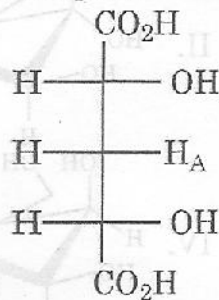
Signature of the Candidate

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Signature of the Invigilator

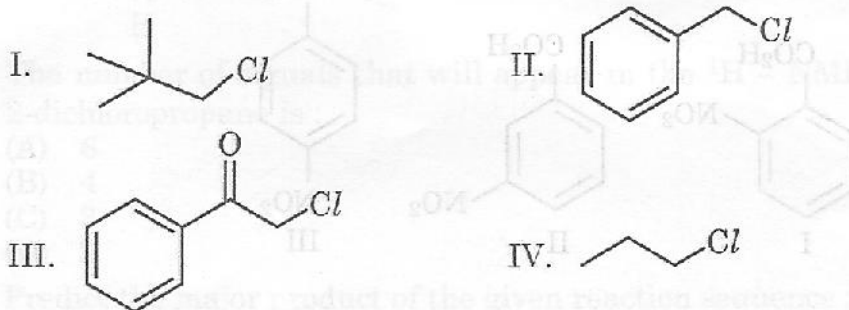


1. Designate the marked 'H' (H_A) in the following organic molecule with appropriate configurational descriptor.



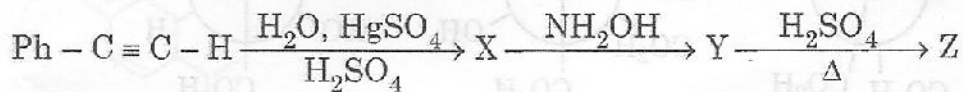
- (A) pro-r
 (B) pro-R
 (C) pro-s
 (D) pro-S

2. Compare the rate of S_N2 reaction among the following alkyl halides :



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

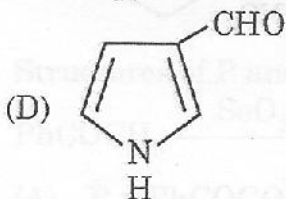
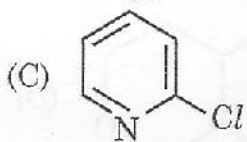
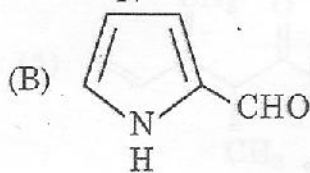
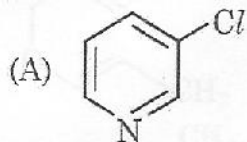
3. Identify the major product (Z) in the following reaction sequence -



- (A) PhCONHCH_3
 (B) $\text{PhCH}_2\text{CONH}_2$
 (C) $\text{PhCH}_2\text{NHCHO}$
 (D) CH_3CONHPh



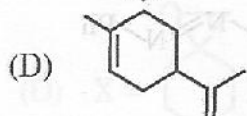
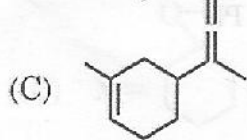
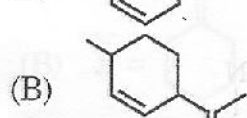
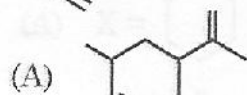
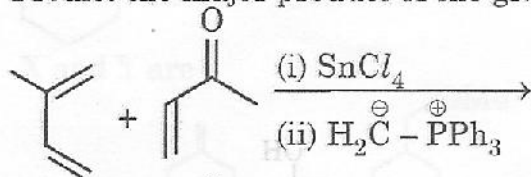
7. Which of the following is not a product of the Reimer-Tiemann reaction of pyrrole with CHCl_3 in alkali ?



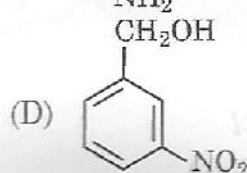
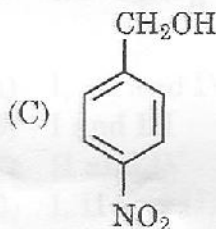
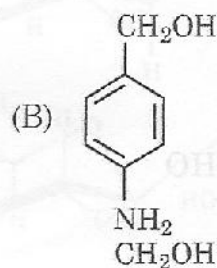
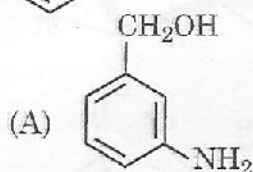
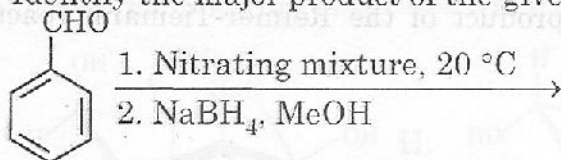
8. The number of signals that will appear in the ^1H - NMR spectrum of (R) - 1, 2-dichloropropane is :

- (A) 6
(B) 4
(C) 3
(D) 2

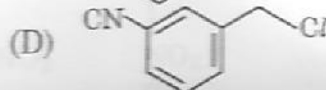
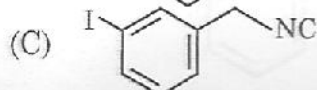
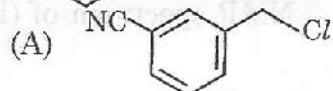
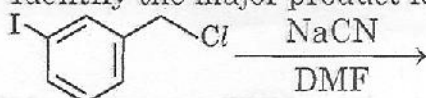
9. Predict the major product of the given reaction sequence :



10. Identify the major product of the given sequence.

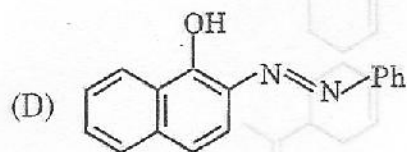
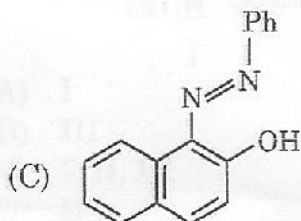
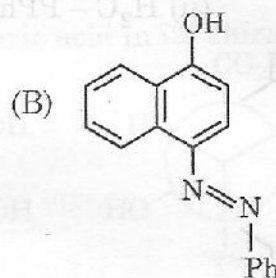
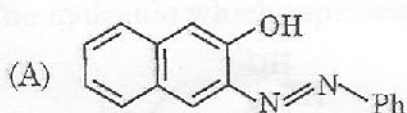


11. Identify the major product for the following reaction :

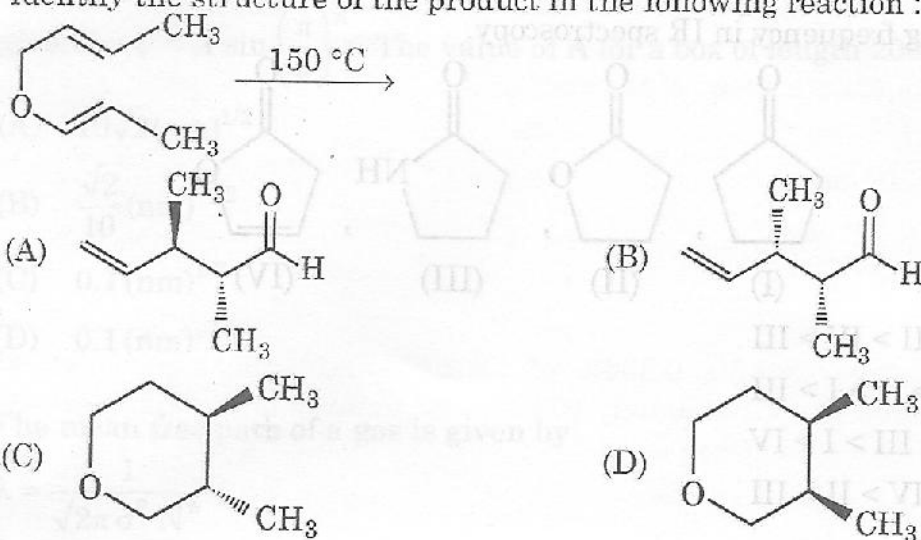


12. X

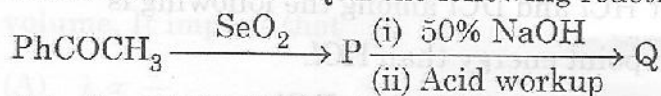
(iii) $\text{Ph} - \overset{\oplus}{\text{N}} \equiv \overset{\ominus}{\text{N}} \text{Cl}$
Structure of X is -



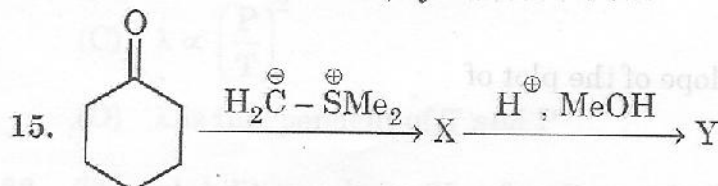
13. Identify the structure of the product in the following reaction :



14. Structures of P and Q in the following reaction sequence are :



- (A) P = PhCOCO₂H; Q = PhCH(OH)CO₂H
 (B) P = PhOCOCH₃; Q = PhOH
 (C) P = PhCOCHO; Q = PhCH(OH)CO₂H
 (D) P = PhCOCHO; Q = PhCOCO₂H

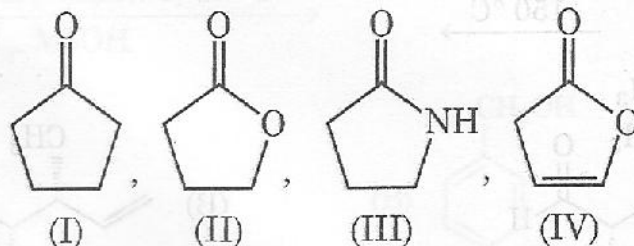


X and Y are

- (A) X = ; Y =
- (B) X = ; Y =
- (C) X = ; Y =
- (D) X = ; Y =



16. Arrange the following organic molecules in the decreasing order of C=O stretching frequency in IR spectroscopy.



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

17. The correct statement about HCl and DCl among the following is

- (A) DCl has a smaller zero-point energy than HCl.
 (B) HCl has smaller vibrational frequency than DCl.
 (C) The force constant of the HCl bond is half of DCl.
 (D) The reduced mass of DCl is smaller than HCl.

18. ΔH of a reaction is equal to slope of the plot of

- (A) ΔG vs $\frac{1}{T}$
 (B) ΔG vs T
 (C) $\left(\frac{\Delta G}{T}\right)$ vs T
 (D) $\left(\frac{\Delta G}{T}\right)$ vs $\frac{1}{T}$

19. The standard EMF of the cell Pt, H₂(g) | HCl (soln) | AgCl(s), Ag(s)

- (A) increases with increase in T
 (B) decreases with increase in T
 (C) remains unchanged with T
 (D) decreases with HCl concentration



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20. The wave function for a quantum mechanical particle in a 1D box of length a is

given by $\psi = A \sin \left(\frac{\pi}{a} \right)^n$. The value of A for a box of length 200 nm is

- (A) $10\sqrt{2}(\text{nm})^{1/2}$
- (B) $\frac{\sqrt{2}}{10}(\text{nm})^{-1/2}$
- (C) $0.1(\text{nm})^{1/2}$
- (D) $0.1(\text{nm})^{-1/2}$

21. The mean free path of a gas is given by

$$\lambda = \frac{1}{\sqrt{2}\pi\sigma^2 N^*}$$

where σ is the molecular diameter and N^* is the number of molecules per unit volume. It implies that

- (A) $\lambda \propto \frac{P}{T}$
- (B) $\lambda \propto \frac{T}{P}$
- (C) $\lambda \propto \left(\frac{P}{T} \right)^2$
- (D) λ is independent of T and P

22. The solubility products (K_{sp}) for three salts MX , MY_2 , MZ_3 are 1×10^{-8} , 4×10^{-9} and 27×10^{-8} respectively. The solubilities of these salts follow the order

- (A) $\text{MX} > \text{MY}_2 > \text{MZ}_3$
- (B) $\text{MZ}_3 > \text{MY}_2 > \text{MX}$
- (C) $\text{MZ}_3 > \text{MX} > \text{MY}_2$
- (D) $\text{MY}_2 > \text{MX} > \text{MZ}_3$

23. When 100 g of water is reversibly heated from 50°C to 75°C at 1 atm, the change in entropy (JK^{-1}) of the universe is

- (A) -0.31
- (B) 0.31
- (C) 0
- (D) 3.1



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24. The root mean square speed of a gas molecule at 27 K and 1.5 bar pressure is $1 \times 10^4 \text{ cms}^{-1}$. If both temperature and pressure are raised three times, the root mean square speed of the gas will be
- (A) $9 \times 10^4 \text{ cms}^{-1}$
 (B) $3 \times 10^4 \text{ cms}^{-1}$
 (C) $\sqrt{3} \times 10^4 \text{ cms}^{-1}$
 (D) $1 \times 10^4 \text{ cms}^{-1}$
25. Haemoglobin contains 0.334% of Fe by weight. The molecular weight of haemoglobin is approximately 67200. The number of Fe atoms present in one molecule of haemoglobin is
- (A) 1
 (B) 2
 (C) 4
 (D) 6
26. The separation of (123) planes in nm in an orthorhombic cell with $a = 0.25 \text{ nm}$, $b = 0.50 \text{ nm}$ and $c = 0.75 \text{ nm}$ is
- (A) 0.14
 (B) 0.40
 (C) 0.43
 (D) 0.84
27. An aqueous solution containing 1 gL^{-1} of a polymer exerts osmotic pressure of 4 torr at 300 K. Given $R = 0.082 \text{ Latm mol}^{-1} \text{ K}^{-1}$. Find out the molar mass in gmol^{-1} of the polymer.
- (A) 4500
 (B) 4564
 (C) 4674
 (D) 4800
28. A solution is prepared by mixing 100 ml 0.4 M HCl with 100 ml 0.4 M NH_3 at 25°C . The pH of the resulting mixture is (pK_b of NH_4OH at $25^\circ\text{C} = 4.74$)
- (A) 2.87
 (B) 3.37
 (C) 4.05
 (D) 4.98



29. Which of the followings is the correct form of Lennard-Jones potential ?

(A) $u(r) = 4 \varepsilon \left[\left(\frac{\sigma}{r} \right)^6 - \left(\frac{\sigma}{r} \right)^{12} \right]$

(B) $u(r) = 4 \varepsilon \left[\left(\frac{\sigma}{r} \right)^{10} - \left(\frac{\sigma}{r} \right)^5 \right]$

(C) $u(r) = 4 \varepsilon \left[\left(\frac{\sigma}{r} \right)^{12} - \left(\frac{\sigma}{r} \right)^6 \right]$

(D) $u(r) = 4 \varepsilon \left[\left(\frac{\sigma}{r} \right)^5 - \left(\frac{\sigma}{r} \right)^{10} \right]$

$r \rightarrow$ distance between particles

$\varepsilon, \sigma \rightarrow$ constants

30. An ideal gas is expanded isothermally at a temp 300 K in a single step from initial volume $V_i = 1$ litre to final volume $V_f = 2$ litre, in a single step (opposing pressure = final equilibrium pressure). The amount of work done will be

(A) -17.05 litre atm

(B) -1.728×10^3 Joules

(C) -12.3 litre atm

(D) 17.05 litre atm

31. Equilibrium constant (at constant P) of the reaction $A + B \rightleftharpoons P$ has a value equal to 0.1. In a mixture of A, B and P, the values of their partial pressures are 0.2, 0.3 and 0.1 atm respectively. In which direction would the overall reaction go under the condition.

(A) To the right.

(B) The reaction has already reached equilibrium.

(C) To the left.

(D) There is not enough data.



32. Which of the following is true for a micellization process at critical micellar concentration, at a constant pressure and temperature (below Kraft temperature) ?

(A) $\Delta S > 0$, $\Delta H > 0$ and $|\Delta S| < \frac{|\Delta H|}{T}$

(B) $\Delta S > 0$, $\Delta H > 0$ and $|\Delta S| > \frac{|\Delta H|}{T}$

(C) $\Delta S < 0$, $\Delta H < 0$ and $|\Delta S| < \frac{|\Delta H|}{T}$

(D) $\Delta S < 0$, $\Delta H < 0$ and $|\Delta S| > \frac{|\Delta H|}{T}$

33. A gas assumed to be ideal and undergoing a reversible adiabatic expansion obeys the relation $T \propto V^n$. For such an expansion it is observed that $\frac{V_f}{V_i} = 8$

and $\frac{T_i}{T_f} = 4$. From this observation it may be concluded that the gas is

- (A) Helium
- (B) Hydrogen
- (C) Carbon dioxide
- (D) Ammonia

34. The electrode potential of a silver electrode ($E_{\text{Ag}^+/\text{Ag}}^\circ = +0.799 \text{ V}$) immersed in a 0.05 (M) NaCl solution will be _____. ($K_{\text{sp}}[\text{AgCl}] = 1.82 \times 10^{-10}$)

- (A) 0.222 V
- (B) 0.399 V
- (C) 0.299 V
- (D) 0.699 V

35. The formal potential for a hydrogen electrode at pH = 10 is

- (A) 0.00 V
- (B) 0.591 V
- (C) -0.591 V
- (D) -0.059 V



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36. The compound $(\text{SiH}_3)_3\text{N}$ is expected to be –
 (A) Pyramidal and more basic than $(\text{CH}_3)_3\text{N}$.
 (B) Planar and less basic than $(\text{CH}_3)_3\text{N}$.
 (C) Pyramidal and less basic than $(\text{CH}_3)_3\text{N}$.
 (D) Planar and more basic than $(\text{CH}_3)_3\text{N}$.
37. The correct order of increasing ionic character is
 (A) $\text{BeCl}_2 < \text{MgCl}_2 < \text{CaCl}_2 < \text{BaCl}_2$
 (B) $\text{BaCl}_2 < \text{CaCl}_2 < \text{MgCl}_2 < \text{BeCl}_2$
 (C) $\text{MgCl}_2 < \text{BeCl}_2 < \text{BaCl}_2 < \text{CaCl}_2$
 (D) $\text{BaCl}_2 < \text{CaCl}_2 < \text{BeCl}_2 < \text{MgCl}_2$
38. The ground state term symbol for V^{3+} ion is
 (A) ${}^3\text{F}_2$
 (B) ${}^5\text{D}_0$
 (C) ${}^3\text{F}_4$
 (D) ${}^2\text{D}_{5/2}$
39. Which of the following has a peroxy linkage ?
 (A) $\text{H}_2\text{S}_2\text{O}_3$
 (B) H_2SO_5
 (C) $\text{H}_2\text{S}_4\text{O}_6$
 (D) $\text{H}_2\text{S}_2\text{O}_7$
40. Which one of the following is the correct representation of tetrammine copper (II) hexacyanoferrate (III) ?
 (A) $[\text{Cu}(\text{NH}_3)_4][\text{Fe}(\text{CN})_6]$
 (B) $[\text{Cu}(\text{NH}_3)_4]_3[\text{Fe}(\text{CN})_6]$
 (C) $[\text{Cu}(\text{NH}_3)_4]_4[\text{Fe}(\text{CN})_6]_2$
 (D) $[\text{Cu}(\text{NH}_3)_4]_3[\text{Fe}(\text{CN})_6]_2$
41. Which one among the following exhibits optical isomerism ?
 (A) Cis – $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
 (B) Trans – $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
 (C) Cis – $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$
 (D) Trans – $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$



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42. The experimental magnetic moment of $K_3[Fe(CN)_6]$ is $2.3 \mu_B$ and is attributed to
- spin only magnetic moment value of low spin Fe^{3+} .
 - spin only magnetic moment value of high spin Fe^{3+} .
 - low spin Fe^{3+} with orbital contribution.
 - high spin Fe^{3+} with orbital contribution.
43. The neutral complex which follows the 18 electron rule is
- $(\eta^5 - C_5H_5)Fe(CO)_2$
 - $(\eta^5 - C_5H_5)Mo(CO)_3$
 - $(\eta^5 - C_5H_5)_2CO$
 - $(\eta^5 - C_5H_5)Re(\eta^6 - C_6H_6)$
44. The correct order of CO stretching frequency is
- $[Ti(CO)_6]^{2-} > [V(CO)_6]^- > CO > [Cr(CO)_6]$
 - $[Cr(CO)_6] > CO > [V(CO)_6]^- > [Ti(CO)_6]^{2-}$
 - $CO > [V(CO)_6]^- > [Ti(CO)_6]^{2-} > [Cr(CO)_6]$
 - $CO > [Cr(CO)_6] > [V(CO)_6]^- > [Ti(CO)_6]^{2-}$
45. Calculate the equivalence point potential of the titration of Te^{2+} by MnO_4^- at 1(N) H_2SO_4 medium
- $$E_{eq} = \frac{E_{Fe^{3+}/Fe^{2+}}^\circ + 5E_{MnO_4^-/Mn^{2+}}^\circ}{6}$$
 - $$E_{eq} = \frac{5E_{Fe^{3+}/Fe^{2+}}^\circ + E_{MnO_4^-/Mn^{2+}}^\circ}{6}$$
 - $$E_{eq} = \frac{E_{Fe^{3+}/Fe^{2+}}^\circ + 5E_{MnO_4^-/Mn^{2+}}^\circ}{5}$$
 - $$E_{eq} = \frac{5E_{Fe^{3+}/Fe^{2+}}^\circ + E_{MnO_4^-/Mn^{2+}}^\circ}{5}$$
46. $KMnO_4$ is an oxidant. The equivalent weight of it in alkaline medium is
- MW/5
 - MW/7
 - MW/4
 - MW/3



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47. Among $[\text{Fe}(\text{CN})_6]^{4-}$, $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$, $[\text{CoF}_6]^{3-}$ and $[\text{RhF}_6]^{3-}$, the paramagnetic complex is _____.
- (A) $[\text{Fe}(\text{CN})_6]^{4-}$
(B) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
(C) $[\text{CoF}_6]^{3-}$
(D) $[\text{RhF}_6]^{3-}$
48. The variation of lattice enthalpy of the solid fluorides, MnF_2 , FeF_2 , CoF_2 and NiF_2 in which each metal ion is surrounded by an octahedral array of F^- ions, follows the order :
- (A) $\text{NiF}_2 < \text{CoF}_2 < \text{FeF}_2 < \text{MnF}_2$
(B) $\text{FeF}_2 < \text{CoF}_2 < \text{MnF}_2 < \text{NiF}_2$
(C) $\text{CoF}_2 < \text{FeF}_2 < \text{MnF}_2 < \text{NiF}_2$
(D) $\text{MnF}_2 < \text{FeF}_2 < \text{CoF}_2 < \text{NiF}_2$
49. Among FeF_3 , FeCl_3 , FeBr_3 and FeI_3 , the least stable compound is –
- (A) FeF_3
(B) FeCl_3
(C) FeBr_3
(D) FeI_3
50. The pH of a buffer solution containing 4×10^{-3} moles of acetic acid ($\text{pK}_a = 4.76$) and 0.4 moles of sodium acetate will be
- (A) 6.76
(B) 4.76
(C) 2.76
(D) 0.76

