

UGC POINT

LEADING INSTITUTE FOR CSIR-JRF/NET,GATE & JAM

BOOKLET CODE

A

SUBJECT CODE

CHEMICAL SCIENCE**01****TEST SERIES # 2****INORGANIC CHEMISTRY**

Date: 26/5/2015
Maximum Marks: 170

Timing: 2:00 Hrs

Instructions

1. This test paper has a total of 60 questions carrying 170 marks. The entire question paper is divided in two sections, A and B. All sections are compulsory. Question in each section are different type.
2. **Part-A.** This section has 35 Questions of 2 Marks carries a total of 70 marks.
3. **Part-B.** This section has 25 Questions of 4 Marks carries a total of 100 marks
4. Read the Questions carefully and mark your appropriate response to the OMR sheet
5. There is Negative marking of 1/4 for Each wrong answer
6. Mark the response by **Black** or **Blue** Ball Pen only
7. Any other belongings like Book/ Notes / Electronic device etc are not permitted in the examination hall.
8. Submit your answer sheet (OMR Sheet) to the invigilator before leaving the examination hall



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PART-A

- The possible microstate for 3P_2 and ${}^4T_{2g}$ is,
(1) 5, 10 (2) 5, 12 (3) 9, 12 (4) 9, 8
- Which of the following species / molecules has a planar geometry?
(1) $Ni(CO)_4$ (2) SF_4
(3) $CoCl_4^{2-}$ (4) XeF_4
- Which of the following will act as an acid in SO_2 according to solvent system concept?
(1) $SOCl_2$ (2) Na_2SO_4 (3) K_2SO_3 (4) HCl
- The lowest energy term in following is 1P , 2P , 3F , 1F ,
(1) 1P (2) 2P (3) 3F (4) 1F
- The alkali metal halides are ionic in nature with the exception of
(1) Cesium halide (2) lithium halide
(3) Rubidium halide (4) potassium halide
- Which one of the following oxide is most acidic
(1) BeO (2) Na_2O (3) MgO (4) CaO
- The correct d- electron configuration showing spin- orbital coupling is
(1) $t_{2g}^4 e_g^2$ (2) $t_{2g}^6 e_g^0$ (3) $t_{2g}^3 e_g^0$ (4) $t_{2g}^3 e_g^2$
- The Alkali metals dissolve in liquid ammonia (NH_3), it is found that
(1) The dilute solutions are blue but the color changes to bronze with increasing concentration
(2) The blue solution are paramagnetic but the bronze solutions are diamagnetic
(3) The blue color is due to the presence of solvated electrons
(4) All the facts given above are found to be correct
- The structure of Zintl ion Sb_4^{2-} is
(1) Closo (2) Nido (3) Arachno (4) Hypo
- In solid state PCl_5 is
(1) Ionic and contains PCl_4^- and PCl_6^+
(2) Ionic and contains PCl_4^+ and PCl_6^-
(3) Covalent and contains PCl_3 and Cl_2
(4) Contains discrete PCl_5 unit

11. Peroxoacids of Sulphur is

- (1) H_2SO_3 and H_2SO_5 (2) H_2SO_4 and H_2SO_3
 (3) H_2SO_5 and $H_2S_2O_8$ (4) $H_2S_2O_7$ and $H_2S_2O_8$

12. Which of the following complex ion show minimum intensity of absorption in the UV-Visible region;

- (1) $[Cr(H_2O)_6]^{2+}$ (2) $[V(H_2O)_6]^{2+}$ (3) $[Mn(H_2O)_6]^{2+}$ (4) $[Co(H_2O)_6]^{2+}$

13. Both NF_3 and NCl_3 are covalent but they differ in the extent of hydrolysis because

- (1) Dipole moment of NF_3 is greater than that of NCl_3
 (2) Electronegativity of F is greater than that of Cl
 (3) NF_3 is more stable than NCl_3 and hydrolysis products of NH_3 and NOF , does not exist
 (4) Cl can expand its octet by using d-orbitals

14. Shape of $[XeF_5]^-$ is

- (1) Trigonal bipyramidal with no lone pair
 (2) Pentagonal planar with 2 axial positions occupied by lone pair
 (3) Pentagonal bipyramidal with 2 axial positions occupied by lone pair
 (4) Square pyramidal with no lone pair

15. The correct order of crystal field splitting energy is;

- (1) $[NiCl_4]^{-2} > [FeCl_6]^{-3} > [PtCl_4]^{-2}$
 (2) $[PtCl_4]^{-2} > [FeCl_6]^{-3} > [NiCl_4]^{-2}$
 (3) $[PtCl_4]^{-2} > [NiCl_4]^{-2} > [FeCl_6]^{-3}$
 (4) $[PtCl_4]^{-2} \approx [NiCl_4]^{-2} > [FeCl_6]^{-3}$

16. Using the Wade's rules the structure of $B_{10}C_2H_{12}$ can be predicted. The structure and the number of isomers of $B_{10}C_2H_{12}$ respectively are

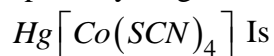
- (1) Nido and two (2) Closo and three
 (3) Closo and one (4) Nido and three

17. The rate of exchange of cyanide ligands in the complexes ,

- (i) $[Ni(CN)_4]^{-2}$, (ii) $[Mn(CN)_6]^{-3}$, (iii) $[Mn(CN)_6]^{-3}$ by ^{14}CN , follows the order

- (1) (ii) > (i) > (iii) (2) (iii) > (i) > (ii)
 (3) (i) > (iii) > (ii) (4) (i) > (ii) > (iii)

18. Spin only magnetic moment of the compound



- (1) $\sqrt{3}$ (2) $\sqrt{8}$ (3) $\sqrt{15}$ (4) $\sqrt{24}$

19. The number of manganese ions in tetrahedral and octahedral sites respectively in Mn_3O_4 are

- (1) One Mn^{2+} and two Mn^{3+} (2) One Mn^{3+} and two Mn^{2+}
(3) Two Mn^{3+} and one Mn^{2+} (4) Two Mn^{2+} and one Mn^{3+}

20. Metal to ligand CT-Spectra occurs in

- (1) MnO_4^- (2) CrO_4^{2-} (3) $[Fe(bpy)_3]^{2+}$ (4) $Cr_2O_7^{2-}$

21. The separation of lanthanides in ion exchange method is based on

- (1) Oxidation state of the ion (2) Size of hydrated ions
(3) Basicity of lanthanides (4) The solubility of their nitrates

22. Aqueous complex of Co^{+2} ion is light pink in color but when this complex is treated with excess of Cl^- ion then deep blue colour appears. This blue colour of complex is due to formation of

- (1) Octahedral $[Co(H_2O)Cl_5]^{-3}$ (2) Tetrahedral $[CoCl_4]^{-2}$
(3) Octahedral $[CoCl_6]^{-3}$ (4) Tetrahedral $[CoCl_2(H_2O)_2]$

23. A true statement about base hydrolysis of $[Co(NH_3)_5Cl]^{+2}$ is;

- (1) It is first order reaction.
(2) The rate determine step involves the dissociation of chloride is $d-[Co(NH_3)_4(NH_2)Cl]^{+1}$
(3) The rate is independent of the concentration of the base.
(4) The rate determines step involves the absorption of a proton from $[Co(NH_3)_5Cl]^{+2}$.

24. Iron-Sulphur cluster in biological system are involved in

- (1) Proton transfer (2) Oxygen transfer
(3) Energy transfer (4) Electron transfer

25. Among the following diatomic molecule which one show EPR signals

- (1) Li_2 (2) B_2 (3) C_2 (4) N_2

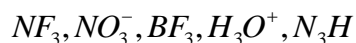
26. Although Fe(III) is a better Lewis acid as compared to Zn(II), but most hydrolytic enzymes constants, Zn(II) at the active site, because.

- (1) Fe(III) is a redox active ion
(2) Fe(III) has less abundance as compared to Zn(II)
(3) Fe(III) generally makes octahedral complex while Zn (II) makes tetrahedral complex.
(4) Zn(II) makes kinetically labile complex

27. Which of the following molecule / ion has D_{3h} symmetry?

- (1) $[H_3O]^+$ (2) $CHCl_3$ (3) CO_3^{2-} (4) NF_3

28. Among the following species, identify the isostructural pairs



- (1) $[NF_3, NO_3^-]$ & $[BF_3, H_3O^+]$ (2) $[NF_3, N_3H]$ & $[NO_3^-, BF_3]$
 (3) $[NF_3, H_3O^+]$ & $[NO_3^-, BF_3]$ (4) $[NF_3, H_3O^+]$ & $[N_3H, BF_3]$

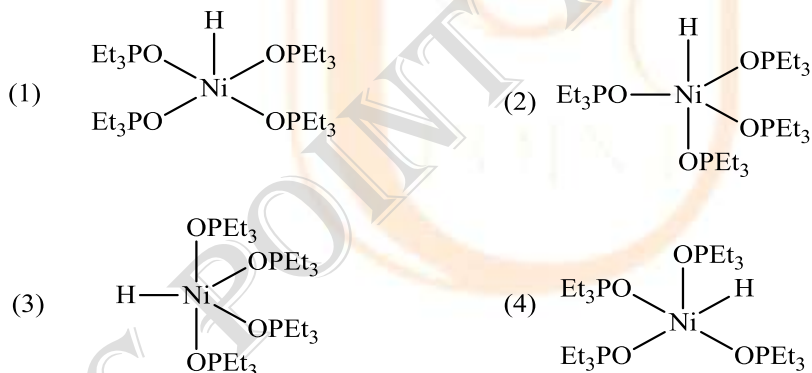
29. The Styx code & type of structure for pentaborane-9 are

- (1) 3203 & Arachano (2) 3203 & Closo
 (3) 4120 & Nido (4) 4120 & Arachano

30. The highest IR stretching frequency for the metal and carbon is in

- (1) $Mn(CO)_5^-$ (2) $Mn(CO)_4^{3-}$
 (3) $Fe(CO)_5$ (4) $Fe(CO)_4^{2-}$

31. Actual NMR of $[HNi(OPEt_3)_4]^{-1}$ shows a quintet at high field than TMS what is possible correct structure?



32. Solid $Co_2(CO)_8$ shows IR carbonyl stretching band at 1857, 1886, 2031, 2044, 2039, 2071, 2112 cm^{-1} .

When $Co_2(CO)_8$ is dissolved in Hexane, the carbonyl bands at 1857 and 1886 cm^{-1} disappear. These change in the IR – spectrum in hexane is due to;

- (1) Loss of terminal CO
 (2) Structural change of $Co_2(CO)_8$ involve conversion of terminal CO to bridging CO.
 (3) Dissociation of $Co_2(CO)_8$ to $Co(CO)_4$
 (4) Structural changes of $Co_2(CO)_8$ involving conversion of bridging CO to terminal CO.

33. The total no. of metal-metal bond in $Ru_3(CO)_{12}$ and $Co_4(CO)_{12}$, respectively are
 (1) 3 and 6 (2) 4 and 5
 (3) 0 and 4 (4) 3 and 4
34. The reaction between $[PdCl_4]^{2-}$ and C_2H_4 produces a new compound compared to free C_2H_4 and C-C bond order of the product is
 (1) Between 1 and 2 (2) Less than 1
 (3) Unaltered (4) Greater than 2
35. In bis-(dimethylglyoximato)nickel(II), the number of Ni-N, Ni-O, and intermolecular hydrogen bond(s) respectively are
 (1) 4, 0 and 2 (2) 2, 2 and 2 (3) 2, 2 and 0 (4) 4, 0 and 1

PART-B

36. The formation of complex take place in following step with stepwise formation constant k_1, k_2, k_3, \dots

$$Cd^{2+} + NH_3 \xrightleftharpoons{k_1} [Cd(NH_3)]^{2+} \xrightleftharpoons[NH_3]{k_2} [Cd(NH_3)_2]^{2+} \xrightleftharpoons[NH_3]{k_3} [Cd(NH_3)_3]^{2+} \xrightleftharpoons{k_4} [Cd(NH_3)_4]^{2+}$$
 The order of formation constants is
 (1) $k_1 > k_2 > k_3 > k_4$ (2) $k_1 < k_2 < k_3 < k_4$
 (3) $k_1 > k_3 > k_4 > k_2$ (4) $k_4 > k_2 > k_3 > k_1$
37. The labiality order in the following complexes is
 (1) $[AlF_6]^{3-} > [SiF_6]^{2-} > [PF_6]^- > [SF_6]$
 (2) $[AlF_6]^{3-} < [SiF_6]^{2-} < [PF_6]^- < [SF_6]$
 (3) $[SiF_6]^{2-} > [AlF_6]^{3-} > [PF_6]^- > [SF_6]$
 (4) $[SF_6] > [SiF_6]^{2-} > [AlF_6]^{3-} > [PF_6]^-$
38. Synthesis of Cis $[PtNH_3NO_2Cl_2]$ can be occurred by following mechanism.
 (1) Reaction of $[PtCl_4]^{2-}$ followed by addition of NO_2 then NH_3
 (2) Reaction of $[PtCl_4]^{2-}$ followed by addition of NH_3 then NO_2
 (3) Reaction of $[PtNH_3]_4^{2+}$ followed by addition by NH_3 then NO_2
 (4) Reaction of $[PtCl_4]^{2+}$ followed by addition of NH_3 then NO_2

39. No interaction between EFG and eQ occurs for:

- (1) $[Fe(CN)_3NO]^{-3}$ (2) $[Fe(CN)_6]^{-4}$ (3) $[Fe(CN)_6]^{-7}$ (4) $[FeF_6]^{-4}$

40. Match the list (I) and (II),

	List (I)		List(II)
P	$(PPh_3)_3 RhCl$	1	Friedel craft catalyst
Q	$[Rh(CO)_2 I_2]^{-1}$	2	Hydroformylation
R	$[PdCl_4]^{2-}$	3	Hydrogenation
S	$[HCo(CO)_4]$	4	The Wacker Process
		5	Monsanto catalyst for acetic acid
		6	Reppe catalyst

The correct order is

- (1) $P \rightarrow 3, Q \rightarrow 2, R \rightarrow 4, S \rightarrow 6$
 (2) $P \rightarrow 3, Q \rightarrow 1, R \rightarrow 4, S \rightarrow 6$
 (3) $P \rightarrow 3, Q \rightarrow 5, R \rightarrow 4, S \rightarrow 2$
 (4) $P \rightarrow 3, Q \rightarrow 6, R \rightarrow 4, S \rightarrow 2$

41. The correct combination of metal, number carbonyl ligands and the charge for a metal carbonyl complex

$[M(CO)_x]^{z-}$, that satisfies the 18-electron rules

- (1) $M = Ti, x=6, z=1$ (2) $M = V, x=6, z=1$
 (3) $M = Co, x=4, z=2$ (4) $M = Mo, x=5, z=1$

42. From the reaction of $NiBr_2$ and Ph_2EtP , it is possible to isolate green crystals of $[Ni(Ph_2EtP)_2 Br_2]$,

which have a magnetic moment of 3.2 BM, and red crystals of $[Ni(Ph_2EtP)_2 Br_2]$, which have a magnetic moment of zero value. When either of these is dissolved in dichloromethane at $40^\circ C$, the resulting solution has a magnetic moment of 2.69 BM, suggest structures of green & red crystals

- (1) Both are tetrahedral
 (2) Both are square planner
 (3) Red crystal is tetrahedral and green is square planner
 (4) Green is tetrahedral and red is square planner

43. For the reaction, $\text{Trans} - [\text{IrCl}(\text{CO})(\text{PPh}_3)_2] + \text{Cl}_2 \rightarrow \text{Trans}[\text{IrCl}_3(\text{CO})(\text{PPh}_3)]$ the correct observation.

- (1) $\nu_{\text{CO}}(\text{Product}) > \nu_{\text{CO}}(\text{reactant})$ (2) $\nu_{\text{CO}}(\text{Product}) < \nu_{\text{CO}}(\text{Reactant})$
 (3) $\nu_{\text{CO}}(\text{Product}) = \nu_{\text{CO}}(\text{reactant})$ (4) $\nu_{\text{CO}}(\text{Product}) = \nu_{\text{CO}}(\text{free CO})$

44. The characteristics spectroscopic feature of quadruple bonded $[\text{Re}_2\text{Cl}_8]^{2-}$ is a strong royal blue colour. This is due to an absorption band in the visible region due to excitation of an electron from $\sigma^2\pi^4\delta^2$ to $\sigma^2\pi^4\delta^1\delta^{*1}$ excited state. This transition is

- (1) Spin allowed and Laporte forbidden
 (2) Spin forbidden and Laporte allowed
 (3) Spin & Laporte both forbidden
 (4) Spin and Laporte both allowed

45. Which of the following will show optical isomers

- (A) $\text{Cis} - [\text{Co}(\text{NH}_3)_2(\text{en})_2]^{+3}$ (B) $\text{Trans} - [\text{IrCl}_2(\text{C}_2\text{O}_4)_2]^{3-}$
 (C) $[\text{Rh}(\text{en})_3]^{3+}$ (D) $\text{Cis} - [\text{Ir}(\text{H}_2\text{O})_3\text{Cl}_3]$

Which of the following option is correct?

- (1) A and C only (2) B and D only
 (3) A, C and D only (4) C only

46. ν_{CO} for $[\text{Fe}(\text{CO})_4]^{2-}$ is 1800 cm^{-1} , then $\nu_{\text{CO}^{17}}$ will be for $[\text{Fe}(\text{CO}^{17})_4]^{2-}$

- (1) 2000 cm^{-1} (2) 2100 cm^{-1}
 (3) 1850 cm^{-1} (4) 1755 cm^{-1}

47. Effective point group of SO_4^{2-} ion of uncoordinated, unidentate, & bidentate, respectively

- (1) D_{4h}, C_{3v}, C_{2v} (2) T_d, C_{3v}, C_{2v}
 (3) D_{4h}, D_{3d}, C_2 (4) D_{3d}, C_{3v}, D_{4d}

48. Consider the statements

- (A) Cytochromes are used for the O_2 transfer
 (B) Ferritin is used for storage of iron (Fe^{+3})
 (C) Hydrogenase contains Fe-metal and it is oxido-reductases enzyme
 (D) Siderophores are used in metal transport

Which of above statements are correct?

- (1) A, B & C (2) B & C (3) B, C & D (4) only A & D

49. Match the following

S.No.	Col(I)	S.No.	Col(II)
A.	Metallothionen	(i)	Ca
B	Calmodulin	(ii)	Fe
C	Hemocyanin	(iii)	Hg & Zn
D	Transferrin	(iv)	Cu

- (1) $A \rightarrow iii, B \rightarrow i, C \rightarrow iv, D \rightarrow ii$
 (2) $A \rightarrow ii, B \rightarrow i, C \rightarrow iv, D \rightarrow iii$
 (3) $A \rightarrow iii, B \rightarrow iv, C \rightarrow i, D \rightarrow ii$
 (4) $A \rightarrow iv, B \rightarrow iii, C \rightarrow ii, D \rightarrow i$

50. The ion exchange chromatography can be used in the separation of

- (I) Rare earth & trans-uranium elements
 (II) Octahedral & tetrahedral complexes
 (III) Zirconium & hafnium
 (IV) Cis-trans isomeric complexes of cobalt & platinum

The correct answer is

- (1) I, II, & III (2) I & IV only (3) I, II, III & IV (4) I, III & IV

51. In metallocenes of Fe, Co & Ni the bond distance of Cp-Cp are 3.29 \AA , 3.44 \AA & 3.63 \AA respectively.

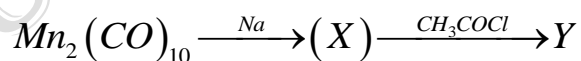
Which of the following statement are true for the explanation of above statement?

- (A) Metal covalent radius decrease from Ni to Fe
 (B) Metal covalent radius decreases from Fe to Ni
 (C) Extra electron of Co and Ni are going in anti-bonding orbitals of (M-Cp)
 (D) Extra electron are going to empty d-orbital's of Co and Ni (Cp-M)

The correct answer is

- (1) A & B only (2) B and C only (3) A, B & C (4) Only B

52. In the reaction below ; X and Y respectively are



- (1) $[Mn(CO)_5]^-$; $[ClMn(CO)_5]$ (2) $[Mn(CO)_5]^-$, $[CH_3C(O)Mn(CO)_5]$
 (3) $[Mn(CO)_4]^{2-}$; $[CH_3C(O)Mn(CO)_5]^-$ (4) $[Mn(CO)_5]^{2-}$; $[CH_3COMn(CO)_4Cl]$

53. Consider the following statements

- (a) The size of the lanthanide M^{+3} ion decreases as the atomic number of M increases
 (b) Electronic spectra of lanthanides show very broad band
 (c) $La(OH)_3$ is less basic than $Lu(OH)_3$
 (d) $Y(acac)_3 \cdot 3H_2O$ is distorted square anti prism, Y is +3 oxidation state

Which of the statements given above are correct?

- (1) 'a' and 'd' (2) 'b' and 'c' (3) only 'a' (d) All of above

54. Match column I (coordination compounds) with column II (Type of Isomerism) and select the correct answer

S.NO	Column I	S.No	Column II
A	$[Co(NH_3)_4Cl_2]^+$	(i)	Ionization isomerism
B	$[Co(end)_2(NO_2)Cl]SCN$	(ii)	Optical isomerism
C	Cis $[Co(end)_2Cl_2]$	(iii)	Geometrical isomerism

- (1) $A \rightarrow iii, B \rightarrow ii, C \rightarrow i$ (2) $A \rightarrow iii, B \rightarrow i, C \rightarrow ii$
 (3) $A \rightarrow i, B \rightarrow iii, C \rightarrow ii$ (4) $A \rightarrow i, B \rightarrow ii, C \rightarrow iii$

55. In the structure of

- (a) IF_2^+ bond angle is smaller than the tetrahedral angle because of lone pair-lone pair repulsion
 (b) IF_4^+ two F-atoms one at equatorial positions and two are inclined at an angle less than 120° due to lone pair-bond pair repulsion
 (c) IF_4^+ , there is sp^3 -hybridisation with bond angle $109^\circ 28'$
 (d) IF_6^+ , there are six bonding electrons and no lone pair.

Select the correct answer

- (1) a, b & c (2) all are correct (3) b and d only (4) a, b & d

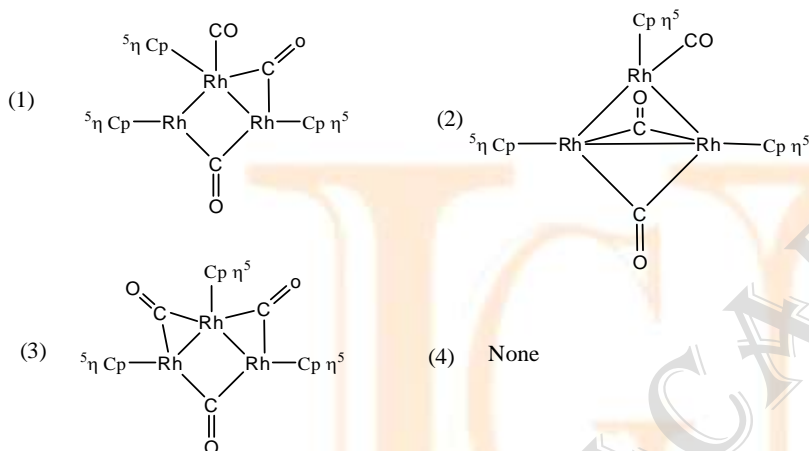
56. The Geometry & point group of complexes $[Zr(CH_3)_6]^{-2}$ and $W(CH_3)_6$ is favored

- (1) Both are octahedral & O_h symmetry
 (2) $[Zr(CH_3)_6]^{-2}$ octahedral and O_h symmetry, and $W(CH_3)_6$ is trigonal prismatic and D_{3h} symmetry
 (3) Both are trigonal prismatic & D_{3h} symmetry
 (4) Both are trigonal prismatic and $[Zn(CH_3)_6]^{-2}$ has D_{3h} symmetry, $W(CH_3)_6$ has D_{3d}

57. CO_2 in water behaves as

1. Weak dibasic acid H_2CO_3
2. Weak monobasic acid $\text{HO}-\text{CO}_2\text{H}$
3. Weak diacidic base $\text{CO}(\text{HO})_2$
4. Weak monoacidic base $\text{HO}-\text{CO}_2\text{H}$

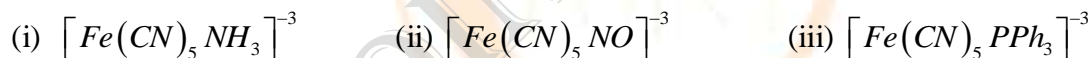
58. Structure of $(\mu\text{CO})_2(\eta^5\text{CpRh})_3\text{CO}$ is



59. Which of the following is correct order of their stability

- (1) $\text{CN} < \text{NO}^+ < \text{NO}^-$
- (2) $\text{NO}^- < \text{CN} < \text{NO}^+$
- (3) $\text{NO}^+ < \text{CN} < \text{NO}^-$
- (4) $\text{CN} < \text{NO}^- < \text{NO}^+$

60. Correct order of quadrupole splitting constant (Δ) values of following complexes in Mossbauer spectra



- (1) (i) > (ii) > (iii)
- (2) (ii) > (iii) > (i)
- (3) (ii) > (i) > (iii)
- (4) (i) > (iii) > (ii)

TEST SEREIS # 2
INORGANIC CHEMSITRY

(Date: 26/5/2015)

ANSWER KEY

1.(2)	2.(4)	3.(1)	4.(3)	5.(2)	6.(1)	7.(1)	8.(4)	9.(3)	10.(2)
11.(3)	12.(3)	13.(3)	14.(2)	15.(2)	16.(2)	17.(1)	18.(3)	19.(1)	20.(3)
21.(2)	22.(2)	23.(4)	24.(4)	25.(2)	26.(4)	27.(3)	28.(3)	29.(3)	30.(2)
31.(1)	32.(4)	33.(1)	34.(1)	35.(1)	36.(1)	37.(1)	38.(2)	39.(2)	40.(3)
41.(2)	42.(4)	43.(1)	44.(4)	45.(3)	46.(4)	47.(2)	48.(3)	49.(1)	50.(4)
51.(2)	52.(2)	53.(1)	54.(2)	55.(4)	56.(3)	57.(1)	58.(2)	59.(2)	60.(2)



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