|     | Self Practic   | e Paper   | (SPP)  | <b></b>  |   |  |  |  |  |
|-----|--|---|--|--|---|--|--|--|--|
| 1.  | In which of the following (1) Ni(CO)₄  | complexes the n<br>(2) K <sub>2</sub> NiF <sub>6</sub>  | iickel metal is in h<br>(3) [Ni(Ni   | highest oxidation $H_3)_6](BF_4)_2$                  | on state ?<br>(4) K₄[Ni(CN) <sub>6</sub> ]  |  |  |  |  |
| 2.  | The EAN of platinum in (1) 46  | potassium hexac<br>(2) 86   | hloroplatinate (IV<br>(3) 36   | ′) is :  | (4) 84  |  |  |  |  |
| 3.  | The IUPAC name of K <sub>2</sub> I<br>(1) Potassium ammined<br>(2) Potassium ammined<br>(3) Potassium ammined<br>(4) Potassium ammined   | Cr(CN) <sub>2</sub> O <sub>2</sub> (O) <sub>2</sub> (NI<br>licyanodioxoperox<br>syanoperoxodioxo<br>licyanoperoxooxo<br>syanodiperoxodiox | H <sub>3</sub> )] is :<br>xochromate(VI)<br>chromium(VI)<br>chromium(VI)<br>xochromate(VI) |  |   |  |  |  |  |
| 4.  | Which one of the follow (1) $[Mn(H_2O)_6]^{2+}$  | ing high-spin com<br>(2) [Cr(H <sub>2</sub> O <sub>6</sub> )] <sup>2+</sup>   | plexes has the la<br>(3) [Mn(H   | argest CFSE ((<br>1 <sub>2</sub> O) <sub>6</sub> ]³+ | Crystal field stabilization energy)<br>(4) [Cr(H <sub>2</sub> O) <sub>6</sub> ] <sup>3+</sup> |  |  |  |  |
| 5.  | Which of the following complex will show optical activity ?(1) trans- $[Co(NH_3)_4Cl_2]^+$ (2) $[Cr(H_2O)_6]^{3+}$ (3) cis- $[Co(NH_3)_2(en)_2]^{3+}$ (4) trans- $[Co(NH_3)_2(en)_2]^{3+}$   |   |  |  |   |  |  |  |  |
| 6.  | Which kind of isomerism is shown by the complex $[Co(NH_3)_5(ONO)]SO_4$ ?1. Ionisation isomerism2. Linkage isomerism3. Geometrical isomerism4. Optical isomerism3. Geometrical isomerism(1) 1, 2, 3 and 4 are correct(2) 1, 3 and 4 are correct only(3) 1 and 2 are correct only(4) 2, 3 and 4 are correct only  |   |  |  |   |  |  |  |  |
| 7.  | <ul> <li>Which of the following statements is correct for complex [Cr(NH<sub>3</sub>)(CN)<sub>4</sub>(NO)]<sup>2-</sup> (given that n = 1)?</li> <li>(1) It is d<sup>2</sup>sp<sup>3</sup> hybridised .</li> <li>(2) The chromium is in +I oxidation state</li> <li>(3) It is heteroleptic complex and its aqueous solution is coloured</li> <li>(4) All of these</li> </ul>   |   |  |  |   |  |  |  |  |
| 8.  | Which one is an outer c<br>(1) [Ni(NH <sub>3</sub> ) <sub>6</sub> ] <sup>2+</sup>  | rbital complex ?<br>(2) [Mn(CN) <sub>6</sub> ]⁴-  | (3) [Co(N  | IH <sub>3</sub> ) <sub>6</sub> ] <sup>3+</sup>       | (4) [Fe(CN) <sub>6</sub> ]⁴-  |  |  |  |  |
| 9.  | <ul> <li>Co-ordination compounds have great importance in biological systems. In this context, which statement is incorrect ?</li> <li>(1) Carboxypeptidase–A is an enzyme and contains zinc.</li> <li>(2) Haemoglobin is the red pigment of blood and contains iron.</li> <li>(3) Cyanocobalmin is B<sub>12</sub> and contains cobalt.</li> <li>(4) Chlorophylls are green pigments in plants and contain calcium.</li> </ul> |   |  |  |   |  |  |  |  |
| 10. | If excess of AgNO <sub>3</sub> solution dichlorobis(ethylenedian (1) 0.0012  | tion is added to 1<br>nine)cobalt (III) c<br>(2) 0.0016   | 00 mL of a 0.024<br>hloride. How mar<br>(3) 0.002  | M solution of<br>ny moles of Ag                      | CI be precipitated ?<br>(4) 0.0048  |  |  |  |  |
| 11. | A complex of certain r<br>same metal with same<br>(1) Co <sup>2+</sup>   | netal has the ma<br>oxidation state ha<br>(2) Mn²+  | ngnetic moment o<br>s zero magnetic<br>(3) Fe <sup>2+</sup>                                | of 4.91 BM w<br>moment. The r                        | hereas another complex of the<br>metal ion could be :<br>(4) Fe <sup>3+</sup>                 |  |  |  |  |
| 12. | Oxidation number of Fe (1) 0   | in violet coloured<br>(2) 2   | l complex Na₄[Fe<br>(3) 3  | (CN)₅(NOS)] is                                       | s :<br>(4) 4  |  |  |  |  |

| 13. | <ul> <li>The co-ordination number of a central metal atom in a complex is determined by :</li> <li>(1) the number of only anionic ligands bonded to metal ion</li> <li>(2) the number of ligands around a metal ion bonded by pi bonds</li> <li>(3) the number of ligands around a metal ion bonded by sigma and pi bonds</li> <li>(4) the number of ligands around a metal ion bonded by sigma bonds</li> </ul>  |   |   |   |  |  |  |  |  |  |
|-----|---|---|---|---|--|--|--|--|--|--|
| 14. | The IUPAC name of [Co(NH <sub>3</sub> ) <sub>6</sub> ] [Cr(C <sub>2</sub> O <sub>4</sub> ) <sub>3</sub> ] is :<br>(1) Hexaamminecobalt(III) tris(oxalato)chromate(III)<br>(2) Hexaamminecobalt(III) tris(oxalato)chromium(III)<br>(3) Hexaamminecobalt(II) tris(oxalato)chromium(III)<br>(4) Hexaamminecobalt(III) trioxalatechromium(III)  |   |   |   |  |  |  |  |  |  |
| 15. | In the compound lithiumtetrahydroaluminate, the ligand is :<br>(1) H <sup>+</sup> (2) H (3) H <sup>-</sup> (4) None of these  |   |   |   |  |  |  |  |  |  |
| 16. | In the coordination con $(1) - 1$   | npound $K_4[Ni(CN)_4]$ , the c (2) 0  | oxidation state of nickel is<br>(3) + 1   | s :<br>(4) + 2  |  |  |  |  |  |  |
| 17. | <ul> <li>[Co(NH<sub>3</sub>)<sub>4</sub>(NO<sub>2</sub>)<sub>2</sub>]Cl exhibits :</li> <li>(1) Ionization isomerism, gemetrical isomerism and optical isomerism</li> <li>(2) linkage isomerism, geometrical isomerism and optical isomerism</li> <li>(3) linkage isomerism, ionization isomerism and optical isomerism</li> <li>(4) linkage isomerism, ionization isomerism and geometrical isomerism</li> </ul> |   |   |   |  |  |  |  |  |  |
| 18. | One mole of $Co(NH_3)_5CI_3$ gives 3 moles of ions on dissolution in water. One mole of this reacts with two moles of AgNO <sub>3</sub> to give two moles of AgCl. The complex is :<br>(1) $[Co(NH_3)_4CI_2]CI.NH_3$ (2) $[Co(NH_3)_4CI]CI_2.NH_3$<br>(3) $[Co(NH_3)_5CI]CI_2$ (4) $[Co(NH_4)_3CI_3].2NH_3$   |   |   |   |  |  |  |  |  |  |
| 19. | $[Fe(en)_{2}(H_{2}O)_{2}]^{2+} + en \rightarrow complex(X). The correct statement about the complex (X) is :(1) it is a low spin complex.(2) it is diamagnetic.(3) it shows geometrical isomerism.(4) (1) and (2) both.$  |   |   |   |  |  |  |  |  |  |
| 20. | Which of the following pairs will show the same magnetic moment ('spin only')?(1) $[Cr(H_2O)_6]^{3+}$ and $[Fe(H_2O)_5NO]^{2+}$ (2) $[Mn(CN)_6]^{4-}$ and $[Fe(CN)_6]^{3-}$ (3) $[Ni(CO)_4]$ and $[Zn(NH_3)_4]^{2+}$ (4) All of these.  |   |   |   |  |  |  |  |  |  |
| 21. | Which of the following does not have a metal-carbon bond?(1) $AI(OC_2H_5)_3$ (2) $C_2H_5MgBr$ (3) $K[Pt(C_2H_4)CI_3]$ (4) $Ni(CO)_4$  |   |   |   |  |  |  |  |  |  |
| 22. | <ul> <li>CN<sup>-</sup> is strong field ligand. This is due to the fact that</li> <li>(1) it carries negative charge</li> <li>(2) it is a pseudohalide</li> <li>(3) it can accept electrons from metal species</li> <li>(4) it forms high spin complexes with metal species</li> </ul>  |   |   |   |  |  |  |  |  |  |
| 23. | The crystal field-splitting for $Cr^{3+}$ ion in octahedral field changes for ligands $I^-$ , $H_2O$ , $NH_3$ , $CN^-$ and the increasing order is :<br>(1) $I^- < H_2O < NH_3 < CN^-$ (2) $CN^- < I^- < H_2O < NH_3$<br>(3) $CN^- < NH_3 < H_2O < I^-$ (4) $NH_3 < H_2O < I^- < CN^-$  |   |   |   |  |  |  |  |  |  |
| 24. | Which of the following (1) $[Ni(H_2O)_6]^{2+}$  | complex ion is not expec<br>(2) [Zn (NH <sub>3</sub> ) <sub>4</sub> ] <sup>2+</sup> | ted to absorb visible light<br>(3) [Cr(NH <sub>3</sub> ) <sub>6</sub> ] <sup>3+</sup> | t<br>(4) [Fe(H <sub>2</sub> O) <sub>6</sub> ] <sup>2+</sup> |  |  |  |  |  |  |

- **25.** Of the following complex ions, the one that probably has the largest overall formation constant,  $K_r$ , is : (1)  $[Co(NH_3)_6]^{3+}$  (2)  $[Co(H_2O)_6]^{3+}$  (3)  $[Co(NH_3)_2(H_2O)_4]^{3+}$  (4)  $[Co(en)_3]^{3+}$
- 26. Which of the following is considered to be an anticancer species?



- **27.** Arrange the following in order of decreasing number of unpaired electrons ?I :  $[Fe(H_2O)_6]^{2+}$ II :  $[Fe(CN)_6]^{3-}$ III :  $[Fe(CN)_6]^{4-}$ IV :  $[Fe(H_2O)_6]^{3+}$ (1) IV, I, II, III(2) I, II, III, IV(3) III, II, I, IV(4) II, III, I, IV
- **28.** Match List-I (Complexes) with List-II (Hybridization) of central atom and select the correct answer using the codes given below the lists :

|     |   | List-I   |  |                 |  | List-II          |   |  |   |          |  |  |
|-----|---|--|--|-----------------|--|------------------|---|--|---|----------|--|--|
|     | A   | $Ni(CO)_4$   |  |                 | 1.   | sp <sup>3</sup>  |   |  |   |          |  |  |
|     | В   | $[NI(CN)_4]^{2-}$  |  |                 | 2.   | asp <sup>2</sup> |   |  |   |          |  |  |
|     |   | [Fe(CN) <sub>6</sub> ]⁴−<br>[Ma⊑ 14-   |  |                 | 3.<br>1  | sp°a²<br>d²an³   |   |  |   |          |  |  |
|     | Code  |  |  |                 | 4.   | u-sp°            |   |  |   |          |  |  |
|     | Code  | А  | в  | С               | D  |                  |   | А  | в | С        | D  |  |
|     | (1)   | 1  | 3  | 2               | 4  |                  | (2)   | 5  | 2 | 4        | 3  |  |
|     | (3)   | 5  | 3  | 2               | 4  |                  | (4)   | 1  | 2 | 4        | 3  |  |
| 29. | Which o<br>(1) [Cr(l  | /hich of the following complexe<br>) [Cr(NH <sub>3</sub> ) <sub>6</sub> ]Cl <sub>3</sub> (2) [Cr( $\epsilon$ |  |                 |  | s ionizati       | on isom<br>(3) [Cr(   | erism ?<br>en) <sub>3</sub> ]Cl <sub>3</sub>   |   | (4) [Co  | (NH <sub>3</sub> ) <sub>5</sub> Br]SO <sub>4</sub> |  |
| 30. | Coordir   | nation nu  | umber of                                   | Ni in [N        | i(C.O.).] <sup>,</sup>                           | ⁴- is :          |   |  |   |          |  |  |
|     | (1) 3   |  |  | (2) 6           | ( - <u>2</u> - 473 <b>1</b>                      |                  | (3) 4   |  |   | (4) 2    |  |  |
| 31. | An, exa<br>(1) Pota<br>(3) Cup  | imple for<br>assium fe<br>rous sul   | <sup>r</sup> a doubl<br>erricyani<br>phate | e salt is<br>de |  |                  | (2) Cobalt hexamine chloride<br>(4) Mohr's salt             |  |   |          |  |  |
| 32. | The cor   | mplex [P   | $t(NH_3)_6]$                               | Cl₄ furnis      | hes  |                  |   |  |   |          |  |  |
|     | (1) 5 ioi   | 5 ions (2) 4 io  |  |                 |  |                  | (3) 3 ioi   | ns   |   | (4) 2 io | ns   |  |
| 33. | How many isomers are possible in [Co(en                                 |  |  |                 |  |                  |   |  |   |          |  |  |
|     | (1) 2 (2) 4   |  |  |                 |  |                  | (3) 6   |  |   | (4) 1    |  |  |
| 34. | π-bonding is not present in<br>(1) Grignard reagent<br>(3) Zeise's salt |  |  |                 |  |                  | (2) Dibenzene chromium<br>(4) Ferrocene                     |  |   |          |  |  |
| 35. | Grignar<br>(1) Coo<br>(3) Orga  | d reager<br>rdinate o<br>anometa   | nt is a<br>compour<br>allic com            | nd<br>pound     |  |                  | <ul><li>(2) Double salt</li><li>(4) None of these</li></ul> |  |   |          |  |  |
| 36. | Which o<br>(1) [Co(   | hich one of the following com $[Co(F)_6]^{3+}$ (2) [Co   |  |                 | olexes is<br>(H <sub>2</sub> O) <sub>6</sub> ]³+ | parama           | gnetic<br>(3) [Coł  | F <sub>3</sub> (H <sub>2</sub> O) <sub>3</sub> | ] |          | (4) All of these                                   |  |
| 37. | The oxi   | dation st  | tate of F                                  | e in the        | complex  | [Fe(CO           | ) <sub>5</sub> ] is   |  |   |          |  |  |
|     | (1) –1  |  |  | (2) +2          |  | (3) +4           |   |  |   | (4) Zero |  |  |
|     |   |  |  |                 |  |                  |   |  |   |          |  |  |

| 38. | Which of the following is $(1) [Co(NH_3)_3Cl_3]$  | s non-ionizable<br>(2) [Co(NH <sub>3</sub> ) <sub>4</sub> Cl <sub>2</sub> ] Cl | (3) [Co(NH <sub>3</sub> ) <sub>5</sub> Cl]Cl <sub>2</sub>                   | (4) [Co(NH <sub>3</sub> ) <sub>6</sub> ] Cl <sub>2</sub> |  |  |  |  |
|-----|---|--|---|--|--|--|--|--|
| 39. | The coordination and o (1) 6 and 4  | xidation number of X in tl<br>(2) 10 and 3                                     | he compound [X(SO <sub>4</sub> )(N<br>(3) 2 and 6                           | H₃)₅]Cl will be<br>(4) 6 and 3                           |  |  |  |  |
| 40. | In $[NiCl_4]^{2-}$ , the number (1) 4.5   | of unpaired electron is<br>(2) 2   | (3) 3   | (4) 4  |  |  |  |  |
| 41. | AgCI precipitate dissolv<br>(1) [Ag(NH <sub>4</sub> ) <sub>2</sub> ]OH  | es in ammonia due to the (2) [Ag(NH <sub>4</sub> ) <sub>2</sub> ]Cl            | e formation of<br>(3) [Ag(NH <sub>3</sub> ) <sub>2</sub> ]OH                | (4) [Ag(NH <sub>3</sub> ) <sub>2</sub> ]Cl               |  |  |  |  |
| 42. | The oxidation number of (1) +1  | of cobalt in K[Co(CO)₄] is<br>(2) –1   | (3) +3  | (4) –3   |  |  |  |  |
| 43. | The complex salt can b (1) $PO_4^{3-}$  | e made by the combinati<br>(2) Cl⁻   | on of [Co <sup>⊪</sup> (NH <sub>3</sub> )₅Cl] <sup>×</sup> with<br>(3) 2Cl⁻ | n:<br>(4) 2K+  |  |  |  |  |
| 44. | Which one of the following is an inner orbital complex as well as diamagnetic in behaviour (Atomic number :<br>Zn = 30), $Cr = 24$ , $Co = 27$ , $Ni = 28$ )<br>(1) $[Zn(NH_3)_6]^{2+}$ (2) $[Cr(NH_3)_6]^{3+}$ (3) $[Co(NH_3)_6]^{3+}$ (4) $[Ni(NH_3)_6]^{2+}$ |  |   |  |  |  |  |  |
| 45. | The oxidation state of F (1) +2   | e in K₄[Fe(CN) <sub>6</sub> ] is<br>(2) –2                                     | (3) +3  | (4) +4   |  |  |  |  |

|     | SF  | SPP Answers |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1.  | (2) | 2.          | (2) | 3.  | (1) | 4.  | (4) | 5.  | (3) | 6.  | (3) | 7.  | (4) |
| 8.  | (1) | 9.          | (4) | 10. | (3) | 11. | (3) | 12. | (2) | 13. | (4) | 14. | (1) |
| 15. | (3) | 16.         | (2) | 17. | (4) | 18. | (3) | 19. | (4) | 20. | (4) | 21. | (1) |
| 22. | (3) | 23.         | (1) | 24. | (2) | 25. | (4) | 26. | (3) | 27. | (1) | 28. | (4) |
| 29. | (4) | 30.         | (2) | 31. | (4) | 32. | (1) | 33. | (2) | 34. | (1) | 35. | (3) |
| 36. | (4) | 37.         | (4) | 38. | (1) | 39. | (4) | 40. | (2) | 41. | (4) | 42. | (2) |
| 43. | (3) | 44.         | (3) | 45. | (1) |     |     |     |     |     |     |     |     |

# **SPP Solutions**

Let x be the oxidation state of nickel then,
 (1) Ni(CO)<sub>4</sub>; x + 4 (0) = 0 or x = 0;
 (3) [Ni(NH<sub>3</sub>)<sub>6</sub>]<sup>2+</sup>; x + 4 (0) = +2 or x = +2;

(2)  $[NiF_6]^{2-}$ ; x + 6 (-1) = -2 or x = +4;

- (4)  $[Ni(CN)_6]^{4-}$ ; x + 6 (-1) = -4 or x = + 2.
- 4.  $[Mn(H_2O)_6]^{2+} = 3 \times (-0.4) + 2 \times (0.6) = 0$  $[Cr(H_2O)_6]^{2+} = 3 \times (-0.4) + 1 \times (0.6) = 0.6 \Delta_0$  $[Mn(H_2O)_6]^{3+} = 3 \times (-0.4) + 1 \times (0.6) = 0.6 \Delta_0$  $[Cr(H_2O)_6]^{3+} = 3 \times (-0.4) + 0 \times (0.6) = 1.2 \Delta_0$
- (1) trans-[Co(NH<sub>3</sub>)<sub>4</sub>Cl<sub>2</sub>]<sup>+</sup> has plane of symmetry as well as centre of symmetry. Hence it does not show optical isomerism.

(2)  $[Cr(H_2O)_6]^{3+}$  has plane of symmetry as well as centre of symmetry. Hence it does not show optical isomerism.

(3) (C) cis- $[Co(NH_3)_2(en)_2]^{3+}$  lacks one of the symmetry elements.



(4) trans- $[Co(NH_3)_2(en)_2]^{3+}$  has plane of symmetry as well as centre of symmetry. Hence it does not show optical isomerism.

6. NO<sub>2</sub><sup>-</sup> is an ambidentate ligand and can link to central metal ion either through N or O. Hence it show linkage isomerism.

There is exchange of  $NO_2^-$  and  $SO_4^{2-}$  occurs between coordination sphere and ionization sphere. Hence it shows ionisation isomerism.

Ma<sub>5</sub>b has only one form, therefore, it does not show geometrical isomerism.

Ma<sub>c</sub>b has mirror plane, therefore, it does not show optical isomerism.

d<sup>2</sup>sp<sup>3</sup> 1  $[Cr(NH_3)(CN)_4(NO)]^{2-}$ 7.

Central metal ion has one unpaired electron and thus d-d transition of electron is possible. This attributes to the colour of the solution. As different types of ligands are attached to central metal ion, the complex is called heteroleptic complex.

- 8.  $[Ni(NH_2)_e]^{2+}$  has sp<sup>3</sup>d<sup>2</sup> hybridisation having octahedral geometry as with d<sup>8</sup> configuration no two empty d-orbitals are available for d<sup>2</sup>sp<sup>3</sup> hybridisation. As sp<sup>3</sup>d<sup>2</sup> hybridisation involves nd orbital (i.e. outer orbitals), so the complex is called as outer orbital complex.
- 9. Chlorophyll a green pigment in plants contains Mg.
- 10. [CoCl<sub>2</sub>(en)<sub>2</sub>]Cl, One mole complex contains, one mole of ionisable Cl-. One mole of complex = one mole of CI-.

$$\therefore \qquad \text{One mole of AgCI} = \text{One mole of complex} = \frac{100 \times 0.024}{1000} = 0.0024.$$

- $[Fe(H_2O)_6]^{2+}$ 11. n = 4  $\mu = 4.91$ and  $[Fe(H_2O)_6]^{2+}$ n = 0 and  $\mu = 0$
- 13. Coordination number of a central metal atom in a complex is the number of  $\sigma$ -bonds between metal M and ligand L.
- $4K^{+}[Ni(CN)_{1}]^{4-}$ ; let the oxidation state of nickel is x, then x + 4 (-1) = -4 16. So, x = 0
- 17.  $[Co(NH_3)_4(NO_2)_2]CI \& [Co(NH_3)_4(CI)(NO_2)]NO_2 = ionization isomers$  $[Co(NH_3)_4(NO_2)_2]CI \& [Co(NH_3)_4(ONO)_2]CI = linkage isomers$
- Only primary valencies out side the coordination sphere are ionised and these react with AgNO<sub>3</sub> to give 18. white precipitate of AgCI.

 $[Co(NH_2)_5CI]CI_2 \longrightarrow [Co(NH_2)_5CI] + 2CI^2 \xrightarrow{2AgNO_3} 2AgCI + 2NO_2^2$ 

 $[Fe(en)_{2}(H_{2}O)_{2}]^{2+} + en \rightarrow [Fe(en)_{2}]^{2+} + 2H_{2}O$ 19. Complex is [Fe(en),]<sup>2+</sup>. 'en' is a strong field ligand and thus it is inner orbital complex (d<sup>2</sup> sp<sup>3</sup>) and diamagnetic.

It is M(AA)<sub>3</sub> type which has only one form.

(1) Cr<sup>3+</sup>, 3d<sup>3</sup>; sp<sup>3</sup>d<sup>2</sup> hybridisation with three unpaired electrons (weak field as well as strong field 20. ligand).

Fe<sup>+</sup>, 3d<sup>7</sup>; sp<sup>3</sup>d<sup>2</sup> hybridisation with three unpaired electron (one 4s electron jumps to 3d orbital for the pairing)

(2) Mn<sup>2+</sup>, 3d<sup>5</sup>; d<sup>2</sup>sp<sup>3</sup> hybridisation with one unpaired electron after pairing (CN<sup>-</sup> is strong field ligand).

Fe<sup>3+</sup>, 3d<sup>5</sup>; d<sup>2</sup>sp<sup>3</sup> hybridisation with one unpaired electron after pairing (CN<sup>-</sup> is strong field ligand).

(3) Ni, 3d<sup>8</sup> 4s<sup>2</sup>; sp<sup>3</sup> hybridisation and all electrons are paired because CO is strong field ligand (4selectrons jumps to 3d-orbitals for the pairing)

Zn<sup>2+</sup>, 3d<sup>10</sup>; sp<sup>3</sup> hybridisation and all electrons are paired.

21.  $AI(OC_2H_2)_3$  does not have metal-carbon bond (ie, it is not an example of organometallic compound)



- **22.**  $CN^{-}$  is a strong field ligand because it is an example of pseudohalide. Pseudohalide ions are stronger coordinating ligands and they have the ability to form  $\sigma$  and  $\pi$  bonds.
- **23.** (1) The crystal field-splitting for Cr<sup>3+</sup> ion in octahedral field increases with increasing strength of ligands. This order given in (1) is according to spectrochemical series.
- **25.** Chelate complex has higher stability than the similar complexes having monodentate ligands and an higher stability means higher overall formation constant.
- **26.** Cis-platin is the isomer of [Pt(NH<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub>], which is used as an anticancer drug for treating several types of malignant tumours.



**28.**  $[Ni(CO)_4] = sp^3$ ;  $[Ni(CN)_4]^{2-} = dsp^2$ ;  $[Fe(CN)_6]^{4-} = d^2sp^3$ ;  $[MnF_6]^{4-} = sp^3d^2$ .

**29.** (1) No anionic ligand is present in coordination sphere for the exchange with Cl<sup>-</sup> ions present in ionisation sphere.

(2) No anionic ligand is present in coordination sphere for the exchange with Cl<sup>-</sup> ions present in ionisation sphere.

(3) No anionic ligand is present in coordination sphere for the exchange with Cl<sup>-</sup> ions present in ionisation sphere.

(4)  $Br^-$  and  $SO_4^-$  can exchange their positions between coordination sphere and ionisation sphere. Hence it shows ionization isomerism.

- **30.** Coordination number of nickel in  $[Ni(C_2O_4)_3]^{4-}$  is 6 because  $C_2O_{-4}^{2-}$  is a bidentate ligand.
- **32.**  $[Pt(NH_3)_6]CI_4 \rightarrow [Pt(NH_3)_6]^{4+} + 4CI (5ions)$

- 36. As all the ligands are weak so they do to induce pairing of electrons so they show paramagnetism.
- **38.** Atoms present with in co-ordination sphere do not ionise.
- **39.** Co-ordination no. is 6 oxidation state in [X(SO<sub>4</sub>)(NH<sub>3</sub>)<sub>5</sub>]Cl is

$$x -2 = 0 -1$$
  
 $x - 2 + 0 - 1 = 0, \qquad x = +3$ 

**42.** 
$$1 \times (+1) + x + 4 \times (0) = 0$$

 $1 + x = 0 \Rightarrow x = -1$  Oxidation number of Co = -1

**43.** In the complex ion  $[Co^{(III)}(NH_3)_5CI]^x$ , charge on the complex ion

$$x = 3 + (0 \times 5) + (-1)$$
  
 $x = 3 - 1 = 2$ 

Hence, it will combine with that species which have -2 charge to produce a neutral complex salt. So it will combine with  $2CI^{-}$  to produce [Co(NH<sub>3</sub>)<sub>5</sub>CI]Cl<sub>2</sub> complex.