# びdoubtnut 

India's Number 1 Education App

## CHEMISTRY

## BOOKS - CENGAGE CHEMISTRY (ENGLISH)

## COORDINATION COMPOUNDS

## Illustration

1. Why $\mathrm{NH}_{3}$ form coordinate complex, while the isoelectronic species $\mathrm{CH}_{4}$ does not.

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2. Calculate the oxidation number of Ni ion $\left.\left[\mathrm{Ni}\left(\mathrm{H}_{2} \mathrm{O}_{6}\right)_{6}\right]^{2+}\right]$.
3. Calculate the oxidation number of Ni in $\mathrm{K}_{2}\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]$.

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4. What is the coordination number and oxidation state of Al in the complex $\left[\mathrm{AI}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4}(\mathrm{OH})_{2}\right]^{\oplus}$ ? .

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5. In the complex $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{5} \mathrm{CI}\right] B r$, identify
(a) Ligands and their charges
(b) Charge of the central ion in the complex
(c ) What-would happen if $\mathrm{Ag} \mathrm{NO}_{3}$ is added to the compound at $0^{\circ} \mathrm{C}$.

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6. Write the formula for the following coordination compounds
(a) Tetraamineaquachlorido cobat (III) chloride
(b) Postassium tetrahydroxozincate (II)
(c) Potassium trioxalatoaluminate (III)
(d) Dichloridobis (ethane 1, 2 -diamine)cabalt (III) ion
(e) Tetracarbonylnicked (0)

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7. Write the formula for the following coordination compounds
(a) Tetrahydroxozincate (II) chloride
(b) Pentaaquachloridochromium (II) chloride
(c) Tetrabromidocuprate (II) ion

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8. Name of the following complex ions
(a) $\left[\mathrm{PdBr}_{4}\right]^{2-}(b)\left[\mathrm{CuCl}_{2}\right]^{\oplus}$
(c) $\left[A u(C N)_{4}\right] \oplus(d)\left[A l F_{6}\right]^{3-}$
$\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3-(f)}\left[\mathrm{Zn}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$
(g) $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{3-}$.

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9. From the experimental facts given below determine the correct structure of solid $\mathrm{CrCI}_{3} \cdot 6 \mathrm{H}_{2} \mathrm{O}$ Solution containing 0.2665 g of $\mathrm{CrCI}_{3} 6 \mathrm{H}_{2} \mathrm{O}$ was passed throuhg cation exchange resin in acid form The acid liberated was found to react completely with 30 mL of 0.10 M Na OH (Molecular mass of $\mathrm{CrCI}_{3} \cdot 6 \mathrm{H}_{2} \mathrm{O}=266.5$ ).

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10. Which of the following complexes (in solution) will have greater value of molar conductivity Explain giving reason
(a) $\mathrm{K}_{4}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$ and $\mathrm{K}_{3}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$
(b) $\left[P t\left(\mathrm{NH}_{3}\right)_{2} \mathrm{CI}_{2}\right]$ and $\left.\left[\mathrm{Pt}(\mathrm{NH})_{3}\right)_{6}\right] \mathrm{Cl}_{4}$.

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11. Arrange the following compounds in the order of decreasing molar conductivity in aqueous solution.
a. $\mathrm{K}\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2}\left(\mathrm{NO}_{2}\right)_{4}\right]$
b. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{3}\left(\mathrm{NO}_{2}\right)_{3}\right]$
c. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5}\left(\mathrm{NO}_{2}\right)\right]_{3}\left[\mathrm{Co}\left(\mathrm{NO}_{2}\right)_{6}\right]_{2}$
d. $\left[\mathrm{Mg}\left(\mathrm{Cr}\left(\mathrm{NH}_{3}\left(\mathrm{NO}_{2}\right)_{5}\right]\right.\right.$

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12. Arrange the following compounds in the order of decreasing molar conductivity in aqueous solution.
a. $\mathrm{K}\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2}\left(\mathrm{NO}_{2}\right)_{4}\right]$
b. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{3}\left(\mathrm{NO}_{2}\right)_{3}\right]$
c. $\left[\mathrm{Mg}\left(\mathrm{Cr}\left(\mathrm{NH}_{3}\left(\mathrm{NO}_{2}\right)_{5}\right]\right.\right.$

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13. Calculate the EAN of CO in $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$ (Atomic number of $C o=27)$.

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14. On the basis of $E A N$ rule predict the number of unpaired electrons and magnetic moment for the following compounds
(a) $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$
(b) $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right] \mathrm{Cl}_{2}$.

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15. Calculate the EAN of the underlined atoms in the folloiwng complexes.
(a) $[\text { Ca(edta) }]^{2-}$
(b) $\left[N i(p y)(e n)\left(\mathrm{NH}_{3}\right)_{3}\right]^{2+}$.

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16. Dedue the value of $x$ in the following compounds.
(a) $\left[\mathrm{Mo}(\mathrm{CO})_{x}\right]$ (b) $\left[\mathrm{Co}_{2}(\mathrm{Co})_{x}\right]^{2-}$.

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17. Describe a simple test to distinguish between the following pairs of compounds

$$
\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Br}\right] \mathrm{SO}_{4} \text { and (B) }\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{SO}_{4}\right] \mathrm{Br}
$$

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18. Write hydrate isomers of the following and also give increasing order of the conductance of the isomers
$\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right] \mathrm{Br}_{3}$
(b) $\left[\mathrm{Cu}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4}\right] \mathrm{CI}_{2}$.

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19. Why is geometrical isomerism not possible in tetrahedral complexes having two different types of unidentate ligands coordinated with the central metal ion ?

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20. Draw structure of geometrical isomers of $\left[\mathrm{Fe}\left(\mathrm{NH}_{3}\right)_{2}(\mathrm{CN})_{4}\right]$ -

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21. Draw structures of geometrical isomers possible for $\left[\mathrm{Co}(\mathrm{en}) \mathrm{CI}_{2} \mathrm{Br}_{2}\right]^{\Theta}$
22. In the reaction
$\left[\mathrm{CoCl}_{2}\left(\mathrm{NH}_{3}\right)_{4}\right]^{\oplus} \rightarrow\left[\mathrm{CoCl}_{3}\left(\mathrm{NH}_{3}\right)_{3}\right]+\mathrm{NH}_{3}$, only one
isomer of the complex product is obtained. Is the initial complex cis or trans?.

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23. When $\left[\mathrm{Ni}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$ is treated with conc HCI two compounds having the formula $\mathrm{Ni}\left(\mathrm{NH}_{3}\right) \mathrm{CI}_{2}$ (designated as I and II are formed) I can be converted into II ny boiling in dil HCI A solution of I reacts with oxalic acid to form $\mathrm{Ni}\left(\mathrm{NH}_{3}\right)_{2}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)$ II does not react with oxalic acid Deduce the configuration Of I and II and the geometry of Ni (II) complexes .

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24. How can be the following pair of isomers be distinguished from one another

I $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]\left[\mathrm{Cr}\left(\mathrm{NO}_{2}\right)_{6}\right]$ and
(II) $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]\left[\mathrm{Co}\left(\mathrm{No}_{2}\right)_{6}\right]$

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25. Write all geometric isomers for an octahedral complex $\left[\mathrm{MCI}_{2}\left(\mathrm{NH}_{3}\right)_{4}\right]$.

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26. Out of the following two coordiantion entities which is chiral (optically active) ?
(a) cis - $\left[\mathrm{CrCl}_{2}(\mathrm{ox})_{2}\right]^{3-}$
(b) trans - $\left[\mathrm{CrCl}_{2}(\mathrm{ox})_{2}\right]^{3-}$
27. Write the structure and name of the following and their ionisation isomers
$\left[P t\left(\mathrm{NH}_{3}\right)_{3}\left(\mathrm{NO}_{2}\right)\right] C I$
(ii) $\left[\mathrm{Pt}\left(\mathrm{NO}_{2}\right)\left(\mathrm{H}_{2} \mathrm{O}\right)\left(\mathrm{NH}_{3}\right)_{2}\right] \mathrm{Br}$
(iii) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Br}\right] \mathrm{SO}_{4}$.

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28. A coordination compound $\mathrm{CrCl}_{3} \cdot \mathrm{H}_{2} \mathrm{O}$ gives white precipitate of AgCl with $\mathrm{AgNO}_{3}$. The molar conductance of the compound corresponds to two ions. The structural formula of the compound is

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29. Writh the name of the following isomers .
[Cr(en)3][Co(CN)6]

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30. Draw the structures and write the names of all possible isomers of $\left[\operatorname{Pt}(\mathrm{SCN})\left(\mathrm{NH}_{3}\right)\right] S C N$

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31. The complex ion $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Cl}^{2+}(\mathrm{X})\right.$ undergoes a substitution reaction when reacted with $\left(\mathrm{NaNO}_{2}+\mathrm{HCl}\right)$ An unstable scarlet red complex A is formed when dilute acid is used and a stable yellow complex $B$ is formed when concentrated acid is used Both $A$ and $B$ are isomeric pentammine complex ions Give the structures of the ions und name the type of the isomerism involved.
32. What type of isomers are the following
(a) $\left[\mathrm{Mn}(\mathrm{CO})_{5}(\mathrm{SCN})\right]$ and $\left[\mathrm{Mn}(\mathrm{CO})_{5}(\mathrm{NCS})\right]$
(b) $\left[\mathrm{Co}(\mathrm{en})_{3}\right]\left[\mathrm{Cr}(\mathrm{CN})_{6}\right]$ and $\left[\mathrm{Cr}(\mathrm{en})_{3}\right]\left[\mathrm{Co}(\mathrm{CN})_{6}\right]$

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33. Draw all possible isomers of
(i) $\left[\mathrm{Pt}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right]^{2+}$
(ii) $\left[P t(g l y)_{2}\right]^{0}$

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34. Neither optical nor geometrical isomers can be distinguished by mass spectroscopy. Why
(ii) Select the pairs of
(a) Geometrical isomers,(b) Optical isomers
( c ) Identical structures



B.


- $\mathbf{C}$.

D.

E.


(III) Which one of following will show optical activity Identifly the type of insomerisum in (if no isomerism then indicate none


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35. The spin only magnetic moment of $\left[\mathrm{MnBr}_{4}\right]^{2-}$ is 5.9 BM . Predict the geometry of the complex ion ?

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36. Predict the number of unpaired electrons in square planar $\left[\mathrm{PtCI}_{4}\right]^{2-}$ ion.

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37. Magnetic moment value of $\left[\mathrm{Mn}(\mathrm{CN})_{6}\right]^{3-}$ ion in $2.8 B M$ Predict the type of hybridisation and geometry of the ion.

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38. Megnetic moment value of $\left.\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{5}(\mathrm{NO})\right]^{2+}$ ion in 3.89B. $M$ Find the out the oxidation state of iron and type of hybridisation .
39. In what respects do inner orbital octahedral complexes differ from outer orbital octahedral complexes

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40. In $\left[\mathrm{ZnBr}_{4}\right]^{2-}$ electron pairs in $s p^{3}$ hybrid orbitals of the zinc atom form bonds to the bromine atoms. Determine the number of unpaired electrons in the complex

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41. Prove that the lowering of the stabilised orbitals is $0.4 \Delta_{0}$ while raising of the destabilised orbitalsw is $0.6 \Delta_{0}$.
42. For the complex $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$ calculate the total pairing energey in high spin and low spin state Given the mean pairing energey $=23500 \mathrm{~cm}^{-1}$.

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43. Which complex of the following pairs has the larger value of $\Delta_{0}$
(i) $\left[\mathrm{Co}(\mathrm{CN})_{6}\right]^{3-}$ and $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$
(ii) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$ and $\left[\mathrm{CoF}_{6}\right]^{3-}$
(iii) $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$ and $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$.

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44. For $\mathrm{Mn}^{3+}$ ion the electron pairing energey P is $28000 \mathrm{~cm}^{-1} \Delta_{0}$ values for the complexes $\left[\mathrm{Mn}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$ and $\left[\mathrm{Mn}(\mathrm{CN})_{6}\right]^{3-}$ are $21000 \mathrm{~cm}^{-1}$ and $38500 \mathrm{~cm}^{-1}$ respectively Do these complexes have high spin or low spin complexes Also write the configuration corresponding to these states .

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45. For the complex $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$ calculate the total pairing energy in high spin and low spin state. Given the mean pairing energey $=23500 \mathrm{~cm}^{-1}$.

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46. Give reason for the fact that crystal field theory is not applied to complexes of many group metals .

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47. Using CFT depict the electronic configuration of the rhodium ion $\left(R h^{2+}\right)$ in an octahedral field for which the crystal field splitting $\Delta_{0}$ is greater than the pairing eneryg $P$
(b) Calculate the crystal field stabilisation energy for this configuration (in terms of Delta andP)'.

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48. What factor determines whether the crystal field in an octahedral complex is to be regarded as strong or weak? How many d-electrons must be present in orbitals of the central atom atom for there to be an abrupt change in crystal field stabilisation energy strong and weak fields gt

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49. Explain the following giving reasons
$\left[\mathrm{NiCl}_{4}\right]^{2-}$ is tetrahedral and paramagnetic whereas $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ is square plannar and dimagnetic.

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1. Addition of $\mathrm{AgNO}_{3}$ solution to aqueous solution of each of the $\operatorname{Pt}(\mathrm{IV})$ amines viz (i) $\mathrm{PtCI}_{4} \cdot 6 \mathrm{NH}_{3}$ (ii) $\mathrm{PtCI}_{4} \cdot 5 \mathrm{NH}_{3}$ (iii) $\mathrm{PtCI}_{4}$ (iv) $\mathrm{PtCI}_{4} \cdot 3 \mathrm{NH}_{3}$ and (v) $\mathrm{PtCI}_{4} \cdot 2 \mathrm{NH}_{3}$ was found by Werner to give 4, 3, 2, 1 and zero moles of AgCI per mole of the amines repectively How did Werner explain these observations?.

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2. Three compounds $A, B$ and $C$ have empirical formula $\mathrm{CrCI}_{3} \cdot 6 \mathrm{H}_{2} \mathrm{O}$ When 1 go of A was kept in a container with dehydrating agent it lost water content and attained constant weight of 0.865 g When $1 \mathrm{~g} B$ was kept in that vessel it attained a constant weight of $0.932 g$ Compund $C$ showed no loss in water content.
(a) Find the composition of $A, B$.

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3. Calculate the EAN of the central metal in the following complex
(a) $\left[\mathrm{AuCl}_{2}\right]^{\Theta}$,(b) $\left[\mathrm{Al}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{3}\right]^{3-}$,(c) $\left[\mathrm{Cd}\left(\mathrm{I}_{4}\right]^{\Theta}\right.$.

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4. Use the EAN rule to predict the molecular formula for the simple carbonyls of (a) $\operatorname{Cr}(Z=24)$
(b) $\mathrm{Fe}(\mathrm{Z}=26)$ and (c ) $\mathrm{Ni}(\mathrm{Z}=28)$ (Assume that the oxidation state of the metals in the these carbonyls is zero).

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5. A compound with the empirical formula $\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{SO}_{4} \mathrm{Br}$ exists in two forms viz red and violet forms Solution of red form gives a precipitate of AgBr with $\mathrm{AgNO}_{3}$ solution The violet form gives no precipitate with $\mathrm{AgNO}_{3}$ but gives white precipitate with the aquous solution of $\mathrm{BaCI}_{2}$ From the these observations give the structure of each form .
6. Two complexes with empirical formula $\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3}\left(\mathrm{H}_{2} \mathrm{O}\right)_{2} \mathrm{Br}_{2} \mathrm{Cl}$ exists in two isomeric forms $(A)$ and $(B)$. Form $A$ gives two moles of AgBr on treatment with $\mathrm{AgNO}_{3}$ solution whereas form $B$ gives only one mole of AgBr . Give the structural formula of both these isomers. What are these isomer called?

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7. Two complexes with empirical formula $\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3}\left(\mathrm{H}_{2} \mathrm{O}\right)_{2} \mathrm{Br}_{2} \mathrm{Cl}$ exists in two isomeric forms $(A)$ and $(B)$. Form $A$ gives two moles of AgBr on treatment with $\mathrm{AgNO}_{3}$ solution whereas form $B$ gives only one mole of AgBr . Give the structural formula of both these isomers. What are these isomer called?

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8. How many isomers are possible for the complex ion $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)(\mathrm{OH})_{2} \mathrm{Cl}_{3}\right]^{2-}$ ?

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9. For the square planar complex $\left[\mathrm{Pt}\left(\mathrm{NH}_{3}\right)_{4}\left(\mathrm{NH}_{2} \mathrm{OH}\right) p y\left(\mathrm{NO}_{2}\right)\right]^{\oplus}$ how many geometrical isomers are possible .

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10. Give the total number of geometrical and optical isomers give by
$\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right]^{\oplus}$

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11. How many geometrical isomers are there for $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2} \mathrm{Cl}_{4}\right]$ (octahedral) and $\left[\mathrm{AuCl}_{2} \mathrm{Br}_{2}\right]$ (square planar) ?

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12. A complex of the type $\left[M(A A)_{2} X_{2}\right]^{n+}$ is known to be optically active.

What does this indicate about the structure of the complex ? Give one example of such complex.

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13. The formula $\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CO}_{3} \mathrm{Br}$ represents three isomers Draw their structures

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14. On the basic VBT answer the following questions for the 4coordinated complex compounds
$\left[\mathrm{CoBr}_{4}\right]^{2-}$
(i) What is the oxidation state of the central metal atom//ion?
(ii) What type of hybridisation is involved?
(iii) What is the geometry and magnetic behaviour of the complex ion/compound

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15. Explain why a knowledge of magnetic suceptilbility of a complex is often necessary for a correct assignment of the electronic conifiguration according to valence bond theory.

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16. Magetic moment of $\left[\mathrm{CoI}_{4}\right]^{2-}$ is 3.8 BM Using valence bond approach predict the structure of $\left[\mathrm{CoI}_{4}\right]^{2-}$.

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17. A complex of a certain metal ion has a magnetic moment of 4.90BM

Another complex of the same metal ion in the same oxidation state has zero magnetic moment The central metal ion could be which of the following (a) $\mathrm{Cr}^{3+}$,(b) $\mathrm{Mn}^{3+}$ (c) $\mathrm{Fe}^{2+}$

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18. Find out the number of unpaired electrons in strong and weak octahedral for $\mathrm{Cr}^{3+}$ and $\mathrm{Fe}^{2+}$ ions.

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19. Distinguish between the possibillities in complex ions of $\Delta=0$ and $C F S E=0$ Give an example of each .
20. Determine the crystal field stabilisation energy of a $d^{6}$ complex having $\Delta_{0}=25000 \mathrm{~cm}^{-1}$ and $P=1500 \mathrm{~cm}^{-1}$.

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21. Give reason for the fact that amongst $\mathrm{Ni}(\mathrm{CO})_{4}\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ and $\mathrm{NiCI}_{4}^{2-}, \mathrm{Ni}(\mathrm{CO})_{4}$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ are diamagnetic whereas $\left[\mathrm{NiCI}_{4}\right]^{2}$ is paramagnetic are diamagnetic whereas $\left[\mathrm{NiCI}_{4}\right]^{2}$ is paramagnetic .

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22. One the basic of CFT predict the geometry of the compund $K_{3}\left[M n(C N)_{6}\right]$ Also calculate the value of $\mu_{\text {smn }}$ only of the compund.

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23. The enthalpy of hydration of the $\mathrm{Fe}^{2+}$ ion is $11.4 \mathrm{kcal} / \mathrm{mol}$ higher than would be expected if there were no crystal field stabillisation energey Assuming the equo complex to be high spin estimate the magnitude of $\Delta_{0}$ for $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$ ion.

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24. If a complexing metal of the first transition series has a di configuration for what values of could magntic properties alone distinguish between strong field and weak field ligand in octanderal coordination.

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25. In terms of CFT explain why a $d^{9}$ octahedral complex with six identical
ligands is not expected tom have all size $m-L$ distane identical .
26. Derive the geometry of the complex compound corresponding to the brown ring in nitrate test Predict the magnetic moment of the complex .

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27. Which of the electronic configuration according to crystal field theory of the compound is correct $\left[\mathrm{MnF}_{6}\right]^{4-}$ ? .
A. a. $\left(t_{2 g}^{5} e_{g}^{0}\right)$
B. $b .\left(t_{2 g}^{3} e_{g}^{2}\right)$
C. c. $\left(e_{g}^{1} t_{2 g}^{4}\right)$
D. d. $\left(t_{2 g}^{1} e_{g}^{4}\right)$

Answer: b
28. Which of the electronic configuration according to crystal field theory of the compound $R h^{+2}$ with $C N=6$ is correct when $\Delta>P$ ? .
A. a. $\left(t_{2 g}^{6} e_{g}^{1}\right)$
B. b. $\left(t_{2 g}^{5} e_{g}^{2}\right)$
C. c. $\left(t_{2 g}^{5} e_{g}^{1}\right)$
D. d. $\left(t_{2 g}^{3} e_{g}^{3}\right)$

## Answer: b

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29. According to crystal field therory the electronic configuration of the
$\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$ ion when $(\Delta<P)$
( $\Delta=$ CFSE, $P=$ Pairing energy).
A. $3\left(t_{2 g}^{3} e_{g}^{1}\right)$
B. $4\left(t_{2 g}^{3} e_{g}^{1}\right)$
C. $3\left(e_{g}^{1} t_{2 g}^{1}\right)$
D. $3\left(e_{g}^{3} t_{2 g}^{1}\right)$

## Answer: a

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30. According to crystal field therory the electronic configuration of the $\left[\mathrm{FeCI}_{4}\right]^{\Theta}$ ion is .
A. a. $\left(t_{2 g}^{2} e_{g}^{2}\right)$
B. b. $\left(e_{g}^{2} t_{2 g}^{3}\right)$
C. c. $\left(e_{g}^{1} t_{2 g}^{3}\right)$
D. d. $\left(e_{g}^{3} t_{2 g}^{1}\right)$

## Answer: b

31. According to crystal field theory the electronic configuration of the compound $\left[\mathrm{Mn}(\mathrm{CN})_{4}\right]^{2-}$ is $(\Delta>P)$ :
A. $4\left(e^{4} t_{2}^{1}\right)$
B. $\left(e^{2} t_{2}^{3}\right)$
C. $4\left(e^{2} t_{2}^{3}\right)$
D. $3\left(e^{4} \cdot t_{2}^{1}\right)$.

Answer: d

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32. Corystal field splitting energy (CFSE) for the complex $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$ is when $(\Delta<P)$.
A. 1.2Delat ${ }_{0}$
B. $-0.6 \Delta_{0}$
C. $0.6 \Delta_{0}$
D. $1.2 \Delta_{0}$

Answer: b

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33. Crystal field splitting energy (CFSE) for the complex $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$ is (when $\Delta>P$ ).
A. $-1.6 \Delta_{0}+P$
B. $1.6 \Delta_{0}+P$
C. $-c-24 \Delta_{0}+P$
D. $2.4 \Delta_{0}+P$

## Answer: a

34. Crystal field splitting energy (CFSE) for the complex $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$ is when $P=20925 \mathrm{~cm}^{-1}$ and $\Delta_{0}=10462.5 \mathrm{~cm}^{-1}\left(1 \mathrm{kJmo}^{-1}=83.7 \mathrm{~cm}^{-1}\right)$.
A. a. $-75 \mathrm{kJmo}^{-1}$
B. $b .75 \mathrm{kJmo}^{-1}$
C. c. $750 \mathrm{kJmo}^{-1}$
D. d. $-750 \mathrm{kJmo}^{-1}$

## Answer: a

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35. Crystal field splitting energy (CFSE) for the complex $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$ is when $P=125$ and $\Delta_{0}=250 \mathrm{kjmol}^{-1}$.
A. $525 \mathrm{kJmo1}^{-1}$
B. $275 \mathrm{kJmo1}^{-1}$
C. $-275 \mathrm{kJmo}^{-1}$
D. $-525 \mathrm{kJm} 01^{1-}$

## Answer: c

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36. Crystal field splitting energy (CFSE) for the complex $\left[\operatorname{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$ is when $P=125$ and $\Delta_{0}=250 \mathrm{kjmol}^{-1}$.
A. $d^{5}$
B. $d^{6}$
C. $d^{8}$
D. $d^{10}$

## Answer: a

37. In which structure crystal field splitting energey (CFSE) for octahedral complex will be zero when $\Delta<P$.
A. $d^{5}$
B. $d^{6}$
C. $d^{8}$
D. $d^{10}$

## Answer: d

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38. In which structure crystal field splitting energey (CFSE) for octahedral complex will be zero when $\Delta<P$.
A. $-1.0 \Delta_{t}$
B. $1.0 \Delta_{t}$
C. 0
D. $-1.8 \Delta_{t}$

Answer: c

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39. Crystal field splitting energey (CFSE) for the complex $\left[\mathrm{Fe}(\mathrm{CN})_{4}\right]^{\Theta}$ is when $\Delta>P$.
A. $a)-2.0$
B. b) $\Delta+P$
C. c) $2+P$
D. d) 0

## Answer: d

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40. Crystal field splitting energey (CFSE) for the complex $\left[\mathrm{Fe}(\mathrm{O})_{4}\right]^{2-}$ is when $\Delta=125$ and $P=250 \mathrm{kJmo}^{-1}$.
A. $-1.2 \Delta_{t}$
B. $1.2 \Delta_{t}$
C. -8
D. 8

## Answer: a

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41. CFSE for $d^{6}$ octahedral complex having $\Delta=250$ and $P=125 \mathrm{kJmo}^{-1}$ is.
A. $350 \mathrm{KJMO}^{-1}$
B. $-350 \mathrm{kJmo}^{-1}$
C. $475 \mathrm{kJmo}^{-1}$
D. $-475 \mathrm{kJmo}^{-1}$

## Answer: b

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42. The enthalpy of hydration of $\mathrm{Cr}^{+2}$ is $-460 \mathrm{kcal} \mathrm{mol}^{-1} \mathrm{In}$ the absence of CFSE the value for $\Delta H=-424 \mathrm{kcal} \mathrm{mo1} 1^{-1}$ What is the value of $\Delta_{0}$ for $\left.\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right)\right]^{2+}$.
A. 60 kcalmole $^{-1}$
B. -60 kcalmole $^{-1}$
C. 25.7 kcalmole $^{-1}$
D. -25.7 kcalmole $^{-1}$

## Answer: a

## Ex 7.1 Subjective (Terminology)

1. Write the formula of the following compounds according to the IUPA rule
(a) Potassium tetraxoferrate (VI)
(b) Potassium tetrazidocobalt(II)

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2. Name of the following compounds
(a) $\left[\mathrm{Cr}(\text { en })_{2} \mathrm{CI}_{2}\right]_{C I}$
(b) $\left[\mathrm{Pt}(\mathrm{Py})_{4}\right]\left[\mathrm{PtCI}_{4}\right]$

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3. Give the characteristic coordination number of each of the following central metal ions .
(a) $\mathrm{Cu}(\mathrm{I})$
(b) $\mathrm{Cu}($ II)
(c) CO (III)
(d) $\mathrm{Al}($ III)
(e) Zn (II)
(f) Fe (II)
(g) Fe (III)
(h) $\mathrm{Ag}(\mathrm{I})$.

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4. Indicate the oxidation state of the central metal ion in each of the following complex
(a) $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$
(b) $\left[\mathrm{Cu}\left(\mathrm{Br}_{4}\right)\right]^{2-}$
(c) $\left[\mathrm{Cu}(\mathrm{CN})_{2}\right]^{\Theta}$
(d) $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CO}_{3}\right]^{\oplus}$
(e) $\left[\mathrm{PtCI}_{4}\right]^{2-}$
(f) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2}\left(\mathrm{NO}_{2}\right)_{4}\right]^{\Theta}$
(g) $\left.\mathrm{Fe}(\mathrm{CO})_{5}\right)$
(h) $\left[\mathrm{ZnCI}_{4}\right]^{2-}$
(i) $\left[\mathrm{Fe}(\mathrm{en})_{3}\right]^{2+}$.

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5. Calucultae the freezing point of the solution containing $24.8 g$ solute per kg water for each of the following solutes $K_{f}=1.86 \mathrm{C} / \mathrm{m}$
(a) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)\left(\mathrm{NO}_{2-}\right.\right.$ (3) $]$
(b) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4}\left(\mathrm{NO}_{2}\right)\right]\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)\left(\mathrm{NO}_{2}\right)_{4}\right]$
(c) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5}\left(\mathrm{NO}_{2}\right)\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)\left(\mathrm{NO}_{2}\right)_{4}\right]^{2}\right.$
[Mw of (a) ${ }^{\prime} 248 \mathrm{~g}$ (b) 496 g (c) 744 g ]

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## Ex 7.1 Subjective (Effective Atomic Number (Ean))

1. Calculate $E A N$ in
$\left[\operatorname{Cr}(\mathrm{CN})_{6}\right]^{3-}$
(b) $\left[\mathrm{PdXCI}_{4}\right]^{2-}$
(c) $\left[\operatorname{Pt}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$
(d) $\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]^{3-}$.

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2. Calculate "EAN" of metal atoms in the following
(a) $\mathrm{Fe}(\mathrm{CO})_{5}$
(b) $\mathrm{Co}_{2}(\mathrm{CO})_{8}$
(c ) $\mathrm{Fe}(\mathrm{NO})_{2}(\mathrm{CO})_{3}$
(d) $\mathrm{Fe}\left(\mathrm{C}_{5} \mathrm{H}_{5}\right)_{2}$.

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3. $\left[A(C O)_{X}\right]$

Here atomic number of $\mathrm{A}=42$. Find x .

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## Ex 7.1 Subjective (Conductance In Coordination Compounds)

1. Arrange the following compounds in the order of decreasing molar conductivity in aqueous solution.
iii. a. Pt $\left(\mathrm{NH}_{3}\right)_{6} \mathrm{Cl}_{4}$
b. $\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6} \mathrm{Cl}_{3}$
c. $\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{Cl}_{3}$

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2. Two compounds have the empirical formula $\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{3}\left(\mathrm{NO}_{2}\right)_{3}$ in aqueous solution one of these conducts electricity while the other does
not Deduce their probable structures .

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## Ex 7.1 Subjective (Isomerism In Coordination Compounds)

1. how will you distinguish between the following pairs of isomers $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{3}\left(\mathrm{NO}_{2}\right)_{3}\right]$ and $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]\left[\mathrm{Cr}\left(\mathrm{NO}_{2}\right)_{6}\right]$

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2. How many isomers are possible for the complex ion $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)(\mathrm{OH})_{2} \mathrm{Cl}_{3}\right]^{2-}$ ?

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3. The complex $M\left(\mathrm{C}_{4} \mathrm{O}_{4}\right) \mathrm{CI}_{2}\left(\mathrm{NH}_{3}\right)_{2}$ forms two types of ionic coloured crystals viz red (A) and blue (B) A or $B$ reacts with 1 mole of $\mathrm{AgNO}_{3}$ to give
$1 / 2$ mole of a red precipitate Further 1 mole of A reacts slowly with 1 mole of $\mathrm{Ag}_{2} \mathrm{C}_{2} \mathrm{O}_{4}$ to form 2 moles of a white precipitate bit $B$ does not react with $\mathrm{Ag}_{2} \mathrm{C}_{2} \mathrm{O}_{4}$ From the above data Find
(a) the coordination number of $M$
(b) the hybrid orbitals of $M$

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4. The compound $\mathrm{Co}(\mathrm{en})_{2}\left(\mathrm{NO}_{2}\right)_{2} \mathrm{CI}$ has been prepared in these isomeric forms $A, B$ and $C$ A does not react with $\mathrm{AgNO}_{3}$ or (en) and is optically inactive $B$ reacts with $\mathrm{AgNO}_{3}$ but not with (en) and is optically inactive $C$ is optically active and reacts with both $\mathrm{AgNO}_{3}$ and (en) identify each of these isomeric forms and draw their structures .

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5. A solution containing 1 go of the complex
$\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{5} \mathrm{CI}\right] \mathrm{CI}_{2} \mathrm{H}_{2} \mathrm{O}$ was passed through a cation exchanger The acid
liberated was made up to 1 litre Calculate the strength of acid solution ( AwofCr $=52$ and $M w$ of complex $=266.5 g m o 1^{-1}$.

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6. A solution contains 2.675 g of $\mathrm{CoCl}_{3} \cdot 6 \mathrm{NH}_{3}$ (molar mass $=267.5 \mathrm{~g} \mathrm{~mol}^{-1}$ ) is passed through a cation exchanger. The chloride ions obtained in solution were treated with excess of $\mathrm{AgNO}_{3}$ to give 4.78 g of AgCl (molar mass $=143.5 \mathrm{~g} \mathrm{~mol}^{-1}$ ). The formula of the complex is (At. mass of $\mathrm{Ag}=108$
u)

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## Ex 7.1 Objective (Terminology)

1. The oxidation number of Co in $\left[\mathrm{Co}(\mathrm{en})_{3}\right]_{2}\left(\mathrm{SO}_{4}\right)_{3}$ is
$+2$
$+1$

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2. The IUPAC name of the coordination compound $\mathrm{Na}_{3}\left[\mathrm{Ag}\left(\mathrm{S}_{2} \mathrm{O}_{3}\right)_{2}\right]$ is
(a) Sodium silverthiosulphate (I)
(b) Sodium silverhyposulphate (I)
(c ) Sodium bis [argentothiosulphate(I)]
(d) Sodium bis (thiosulphato)argentite .

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3. The IUPAC name of the coordination compound $\left[\mathrm{CuCI}_{2}\left(\mathrm{CH}_{3} \mathrm{NH}_{2}\right)_{2}\right]$ is
(a) Dimethylamine copper(II)chloride
(b) Bis(dimehtylamine copper(II) chloride
(c) Dichloridobis(methylamine)copper(II)
(d) Dichlorobis(dimethylamine) copper(II).

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4. The IUPAC name for $\left[\mathrm{AI}(\mathrm{OH})\left(\mathrm{H}_{2} \mathrm{O}\right)_{5}\right]^{2+}$ is
(a) Pentahyroaluminium hydroxide
(b) Aquometaaluminate ion
(c) Pentaaquaaluminate(III)hydroxide
(d) Pentaaquahydroxoaluminium(III).

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5. IUPAC name of $\left[\mathrm{Pt}\left(\mathrm{NH}_{3}\right)_{3}(\mathrm{Br})\left(\mathrm{NO}_{2}\right) \mathrm{Cl}\right] \mathrm{Cl}$ is

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6. The oxidation number of Cr in $\left[\mathrm{Cr}\left(\mathrm{C}_{6} \mathrm{H}_{2}\right)_{2}\right.$ is
$0(b)+2$
(c) +3
(d) +6 .

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7. Which of the following has five donor (coordinating) sites?
(a) Ethylenediaminetriacetate ion
(b) Diethylene triamine
(c) Ethylenediaminetetracetate ion
(d) Triethylene tetramine .

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8. A chelating agent has ot more than two donor atoms to bind to a single metal ion. Which of the following is not a chelating agent ?
9. The solution of AgBr in presence of large excess of $\mathrm{NH}_{3}$ contains mainly the cation.
(a) $\mathrm{NH}_{4}^{\oplus}$
$A g^{\oplus}$
(c) $\left[\mathrm{Ag}\left(\mathrm{NH}_{3}\right)\right]^{\oplus}$
(d) $\left[\mathrm{Ag}\left(\mathrm{NH}_{3}\right)_{2}\right]^{\oplus}$.

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10. Which of the following species is not expected to be a ligand
$\oplus$
NO
$N H_{4}^{\oplus}$
(c ) $\mathrm{NH}_{2}-\mathrm{NH}_{3}^{\oplus}$
(CO) .
11. The number of donor sites in dimethy1 glyoxime glycinato diethylene triamine and EDTA are respectively

2, 2, 3 and 4
(b) 2, 2, 3 and 6
(c) 2, 2, 2 and 6

2, 3, 3 and 6 .

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12. Which of the following is a double salt ?

Alum
Chrome alum
(c) Microcosmic salt
(d) All of these.
13. When potash alum is dissolved in water the total number of ions produced is
(a) Four
(b) Eight
(c) Ten ItBRgt (d) Thirly -two .

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14. Which of the following statements is correct with regard to complex ion?.
(a) complex ion consists of a central ion bonded to two or more donor ions or molecules usually does not dissociate into simple ions or molecules even in a solution and exhibits properties different from its constituent ions or molecules
(b) The donor ions and molecues which coordinate with the central atom or ion a complex are called ligands

The sum of the number of electrons pressent in the central metal ion or atom and those donated by the ligands is called the effective atomic
number of the central metal aton and this number is usually the same as the atomic number of the next higher noble gas
(d) All of these.

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15. How many mloes of of AgCI would be obtained when 100 mL of
$0.1 \mathrm{MCo}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Cl}_{3}$ is treated with excess of $\mathrm{AgNO}_{3}$ ?
(a) 0.01
(b) 0.02
(c) 0.03
(d) None of these .

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16. 0.001 mol of $\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5}\left(\mathrm{NO}_{3}\right)\left(\mathrm{SO}_{4}\right)$ was passed through a cation exchanger the acid coming out of it reguired 20 mL of 0.1 M NaoH for netralisation Hence the complex is
$\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{SO}_{4}\right] \mathrm{NO}_{3}$
(b) $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{NO}_{3}\right] \mathrm{SO}_{4}$
(c ) $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5}\left(\mathrm{SO}_{4}\right)\right]\left(\mathrm{NO}_{3}\right.$
(d) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Br}\right] \mathrm{SO}_{4}$.

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## Ex 7.1 Objective (Isomerism)

1. Which of the following coordination compounds exhibits ionisation isomerism
(a) $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right] \mathrm{CI}_{3}$
(b) $\left[\operatorname{Cr}(e n)_{3} C I_{3}\right]$
(c ) $\left[C r(e n)_{3}\right] C I_{3}$
(d) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Br}\right] \mathrm{SO}_{4}$.
2. Which of the following complex compounds exhibits cis-trans isomerism
(a) $\left[\operatorname{PtCI}_{2}\left(\mathrm{NH}_{3}\right)_{2}\right]$
(b) $\left[\mathrm{PdCI}_{2} \mathrm{BrI}\right]$
(c) $\left[\mathrm{Pt}\left(\mathrm{NH}_{3}\right)(p y)(\mathrm{CI})(\mathrm{Br})\right]$

All ofh these .

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3. How many geometrical isomers are possible for the square planar complex $\left[\mathrm{Pt}\left(\mathrm{NO}_{2}\right)(p y)\left(\mathrm{NH}_{3}\right)\left(\mathrm{NH}_{2} \mathrm{OH}\right)\right] \mathrm{NO}_{2}$
(a) 'Four
(b) Five
(c) Eight
(d) Three .
4. Consider the following spatial arrangements of the octahedral complex ion $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right]^{\oplus}$


Which of the following statements is incorrect regarding these structures?
(a) I and II are enantiomers
(b) II and III are cis and trans isomers respectively
(c) III and IV are cis and trans isomers respectively
(d) II and IV have identical structures .

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5. Which of the following pairs of structures represent facial and meridional isomers (geometrical isomers) respectively ?



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6. Which of the following are coordination isomers of $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]\left[\mathrm{Cr}(\mathrm{CN})_{6}\right] ?$

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7. Which would exhibit ionisation isomerism
(a) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]\left[\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{3}\right]$
(b) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Br}\right]^{2+} \mathrm{SO}_{4}^{2-}$
(c ) $\mathrm{K}_{3}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$
(d) $K_{3}\left[\mathrm{Fe}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{3}\right]$.

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8. The water-soluble complex among the following is
(a) $\left[\mathrm{Ni}(\mathrm{HDMG})_{2}\right]$
(b) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{CI}_{3}\right]$
(c ) $\mathrm{Ni}(\mathrm{CO})_{4}$
$\left[\mathrm{Ni}(\mathrm{HDMG})_{2}\right] \mathrm{CI}_{2}$.
9. Among the following optical activity is possible in
(a) $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{2}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{CI}\right] \oplus$
(b) $\left.\left.\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)\right)_{4} \mathrm{CI}_{2}\right]^{\oplus}\right]$
(c ) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4}\left(\mathrm{NO}_{2}\right) \mathrm{CI}\right] \oplus$
(d) $\left[\mathrm{Co}(\mathrm{CN})_{5} \mathrm{NC}\right]^{\Theta}$.

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10. When an excess of ammonia solution is added to $\mathrm{CuSO}_{4}$ which solution is formed
(a) $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{2}\right]^{2+}$
(b) $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]^{\oplus}$
(c) $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{2}\right]^{\oplus}$
(d) $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$.
11. Copper sulphate solution reacts with $K C N$ to give
(a) $\mathrm{Cu}(\mathrm{CN})_{2}$
(b) CuCN
(c ) $\mathrm{K}_{2}\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]$
(d) $K_{3}\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]$.

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12. The ionisation isomer of $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4} \mathrm{Cl}_{2}\right] \mathrm{NO}_{2}$
(a) $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4}\left(\mathrm{NO}_{2}\right)\right] \mathrm{CI}_{2}$
(b) $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4} \mathrm{CI}_{2}\right] \mathrm{NO}_{2}$
$\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4} \mathrm{CI}(\mathrm{ONO})\right] C I$
(d) $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4} \mathrm{CI}_{2}\left(\mathrm{NO}_{2}\right)\right] \mathrm{H}_{2} \mathrm{O}$.

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1. One the basis of VBT answer the following complex ions
$\left[T i(b p y)_{3}\right]^{\Theta}$
(a) Type of hybridisation involed
(b) Type of inner or outer orbital octahedral complex
(c ) Magnetic behaviour and $\mu_{\text {sпп }}$ value .

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2. Identify the complex which are coloured and which are colourless

Explain
(a) $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5}(\mathrm{NCS})\right]\left[\mathrm{ZnCI}_{4}\right]$
(b) $\left[\mathrm{Ti}\left(\mathrm{NO}_{3}\right)_{4}\right]$

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3. Write the IUPAC nomenclature of the given complex along with its hybridisation and structure $K_{2}\left[\operatorname{Cr}(\mathrm{NO})\left(\mathrm{NH}_{3}\right)(\mathrm{CN})_{4}\right], \mu=1.73 \mathrm{~B} . \mathrm{M}$

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4. On the basic of CET explaine the following complex of $\mathrm{Co}^{3+}$ like
$\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+},\left[\mathrm{Co}(\text { en })_{3}\right]^{3+}$ and $\left[\mathrm{Co}\left(\mathrm{NO}_{2}\right)_{6}\right]^{3-}$
are diamagntic while $\left[\mathrm{CoF}_{6}\right]^{3-}$ and $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$ are paramagnetic.

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## Ex 7.2 Objective

1. The 0.0001 molal solution of a complex $A B_{10}$ has the freezing point of $-0.0015^{\circ} \mathrm{C}$ in water. Assuming $100 \%$ dissociation of the complex, find the proper representation of the complex $\left[K_{f}\left(\mathrm{H}_{2} \mathrm{O}=1.86 \mathrm{Km}^{-1}\right)\right]$
(a) $\left[A B_{8}\right]$
(b) $\left[A B_{3}\right] B_{7}$
(c) $\left[A B_{7}\right] B_{3}$
(d) $\left[A B_{5}\right] B_{5}$.

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2. Given the following data about the absorption maxium of several complex ions what is the order of $\Delta_{0}$ for these ions? .

Compound
I. $\left[\mathrm{CrCI}_{6}\right]^{3-}$

758
II. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+} \quad 465$
III. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+} 694$
(a) $\Delta_{0}<\delta_{0}(I I)<\Delta_{0}(I I I)$
(b) $\delta_{0}(I I)<\Delta_{0}(I I I)<\Delta_{0}(I I I)$
(c) $\Delta(0)<\delta_{0}(I I I)<\Delta_{0}(I I)$
(d) $\Delta_{0}(I I I)<\Delta_{0}(I I)<\Delta_{0}(I)$.
3. Predict the order of $\Delta_{0}$ for the following compounds
(a) $\left.\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)\right)_{6}\right]^{2+}$
(II) $\left.\left[\mathrm{Fe}(\mathrm{CN})_{2}\left(\mathrm{H}_{2} \mathrm{O}\right)\right)_{4}\right]$
(III) $\left.\left[f e(C N)_{4}\left(\mathrm{H}_{2} \mathrm{O}\right)\right)_{2}\right]^{2-}$
(a) $\delta_{0}<\Delta_{0}($ II $)<\delta_{0}($ III $)$
(b) $\delta_{0}<\Delta_{0}(I)<\delta_{0}(I I I)$
(c) $\delta_{0}<\Delta_{0}(I I I)<\delta_{0}(I I)<\Delta_{0}(I)$
$\delta_{0}<\Delta_{0}(I I)<\delta_{0}(I I I)<\Delta_{0}(I)$.

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4. from the information given in the passage what is the most likely configuration of the cobalt d-electrons for the species (A) $\mathrm{CoCl}_{6}^{3-}$ and (B) $\mathrm{Co}\left(\mathrm{No}_{2}\right)_{6}^{3-}$ ?
(a) both $(A)$ and $(B)$ has low spin (b) both $(A)$ and (B) has low spin (c) both
(A) and (B) has low spin (d) both (A) and (B) has low spin .
5. The hybrisation states of the central atom ion in the complex ions
$\left.\left[\mathrm{FeF}_{6}\right]^{3-},\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)\right)_{6}\right]^{3+}$ and $\left[\mathrm{Ni}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$ are
(a) $s p^{3} d^{2}, d s p^{2}$ and $d^{4} s^{2}$ respectively
(b) all $3 d^{2} 4 s 4 p^{3}$
(c) all $4 s 4 p^{3} 4 d^{2}$
(d) $s p^{3} d^{2}, d s p^{3}$ and $p^{4} d^{2}$ respectively .

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6. Amongst $\mathrm{TiF}_{6}^{2-}, \mathrm{CoF}_{6}^{3-}, \mathrm{Cu}_{2} \mathrm{Cl}_{2}$ and $\mathrm{NiCl}_{4}^{2-}$, which are the colourless species ? (atomic number of $\mathrm{Ti}=22, \mathrm{Co}=27, \mathrm{Cu}=29, \mathrm{Ni}=28$ )

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7. The magnetic moment of a complex ion is $2.83 B M$ The complex ion is
$\left.\left[\mathrm{Cr}\left(\mathrm{H}_{2}\right) \mathrm{O}\right)_{6}\right]^{3+}$
(b) $\left[\mathrm{Cu}(\mathrm{CN})_{6}\right]^{2-}$
(c) $\left.\left[V\left(\mathrm{H}_{2} \mathrm{O}\right)\right)_{6}\right]^{3+}$
(d) $\left[\mathrm{MnCI}_{4}\right]^{2-}$.

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8. Which of the following statements is not true of the reaction given below

$$
\left[\mathrm{Cu}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}+4 \mathrm{NH}_{3} \rightleftharpoons\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}+4 \mathrm{H}_{2} \mathrm{O}
$$

(a) it is a ligand -substition reaction
(b) $\mathrm{NH}_{3}$ is a relatively strong-field ligand while $\mathrm{H}_{2} \mathrm{O}$ is a weak field ligand
(c) During the reaction there is a change in colour from light blue to dark blue
(d) $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$ has a tetrahedral structure and is paramagnetic.

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1. Consider to following isomers of $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2} \mathrm{Br}_{4}\right]^{\Theta}$ and answer the questions


Br
(A)

(C)

(B)


Br
(D)

Select the correct statement .
A. (a)Pairs of $A$ and $D$ are same and pairs of $B$ and $C$ are also same .
B. (b)All have chiral centres .
C. (c) $B$ and $D$ are enantiomers
D. (d) $B$ and $C$ are enantiomers

## Answer: a

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2. Consider to following isomers of $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2} \mathrm{Br}_{4}\right]^{\Theta}$ and answer the questions


Select the correct statement .
A. Pairs of $A$ and $D$ are same and pairs of $B$ and $C$ are also same.
B. All have Chiral centres
C. $B$ and $D$ are enantiomers
D. B and C are enantiomers
3. Consider to following isomers of $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2} \mathrm{Br}_{4}\right]^{\Theta}$ and answer the questions


Select the correct statement .
A. $A$ and $D$ are cis
B. There is geometrical isomerism
C. Both(a) and(b)
D. None of these

## Answer: B

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4. Consider to following isomers of $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2} \mathrm{Br}_{4}\right]^{\Theta}$ and answer the questions


If $P Q R S$ are four different ligands then how many geometric isomers will be found for square planar $[P t P Q R S]^{2+}$.
A. 1
B. 2
C. 3
D. 4

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5. Consider the following experiments and answer the questions at the end of it
(A) When $\mathrm{Fe}(C N)_{2}$ solution is treated with $K C N$ solution species formed no longer gives tests of $\mathrm{Fe}^{2+}$ and $\mathrm{CN}^{\Theta}$
(B) When $K_{2} \mathrm{SO}_{4}$ solution is treated with $\mathrm{A1}_{2}\left(\mathrm{SO}_{4}\right)_{3}$ solution species formed gives tests of $\mathrm{K}^{\oplus}, \mathrm{A1}^{3+}$ and $\mathrm{SO}_{4}^{2-}$

Species formed in experiment $A$ does not give test of $\mathrm{Fe}^{2+}$ and $C N^{\Theta}$ it is due to formation of .
A. $K_{2}\left[\mathrm{Fe}(\mathrm{CN})_{4}\right]$
B. $K_{3}\left[F e(C N)_{5}\right]$
C. $K_{3}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$
D. $K_{4}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$

## Answer: D

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6. Consider the following experiments and answer the questions at the end of it
(A) When $\mathrm{Fe}(C N)_{2}$ solution is treated with $K C N$ solution species formed no longer gives tests of $\mathrm{Fe}^{2+}$ and $\mathrm{CN}^{\Theta}$
(B) When $K_{2} \mathrm{SO}_{4}$ solution is treated with $\mathrm{A1}_{2}\left(\mathrm{SO}_{4}\right)_{3}$ solution species formed gives tests of $K^{\oplus}, \mathrm{Al}^{3+}$ and $\mathrm{SO}_{4}^{2-}$

Species formed in experiment $(B)$ is .
A. Complex
B. Double salt
C. Liquid crystal
D. None of these

## Answer: B

7. Consider the following experiments and answer the questions at the end of it
(A) When $\mathrm{Fe}(C N)_{2}$ solution is treated with $K C N$ solution species formed no longer gives tests of $\mathrm{Fe}^{2+}$ and $\mathrm{CN}^{\Theta}$
(B) When $\mathrm{K}_{2} \mathrm{SO}_{4}$ solution is treated with $\mathrm{A1}_{2}\left(\mathrm{SO}_{4}\right)_{3}$ solution species formed gives tests of $K^{\oplus}, \mathrm{Al}^{3+}$ and $\mathrm{SO}_{4}^{2-}$

EAN of iron formed in (A) is .
A. 26
B. 24
C. 36
D. 38

## Answer: C

8. Consider the following experiments and answer the questions at the end of it
(A) When $\mathrm{Fe}(C N)_{2}$ solution is treated with $K C N$ solution species formed no longer gives tests of $\mathrm{Fe}^{2+}$ and $\mathrm{CN}^{\Theta}$
(B) When $\mathrm{K}_{2} \mathrm{SO}_{4}$ solution is treated with $\mathrm{A1}_{2}\left(\mathrm{SO}_{4}\right)_{3}$ solution species formed gives tests of $K^{\oplus}, A 1^{3+}$ and $\mathrm{SO}_{4}^{2-}$

When the species formed in $A$ is treated with $\mathrm{FeCl}_{3}$ a bule colour is obtained It is due to formation of.
A. $F e^{\left.I I\left[F e^{I I I}(C N)_{6}\right)\right]^{\Theta}}$
B. $\left.F e^{I I I}\left[F e^{I I}(C N)_{6}\right)\right]^{\Theta}$
C. Both(a)and(b)
D. None of these

## Answer: C

## - Watch Video Solution

9. Two research students were instruced intructed to synthesise the complex

$$
\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5}\left(\mathrm{NO}_{2}\right)\right] \mathrm{Br}_{2}
$$

They synthesised the complexes with identical molecular formula molar mass geometry conductane and spin but they differed in colour Based on the above facts answer the following questions

The difference in colour is due to
A. optical isomerism
B. geometrical isomerism
C. linkage isomerism
D. nuclear isomerism

## Answer: C

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10. Two research students were instruced intructed to synthesise the complex

$$
\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5}\left(\mathrm{NO}_{2}\right)\right] \mathrm{Br}_{2}
$$

They synthesised the complexes with identical molecular formula molar mass geometry conductane and spin but they differed in colour Based on the above facts answer the following questions

Which of the ligands can show ambidentate property?
A. $\mathrm{NO}_{2}{ }^{\Theta}$
B. $\mathrm{NH}_{3}$
C. $\mathrm{H}_{2} \mathrm{O}$
D. $\mathrm{CO}_{3}{ }^{2-}$

## Answer: A

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11. Two research students were instruced intructed to synthesise the complex
$\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5}\left(\mathrm{NO}_{2}\right)\right] \mathrm{Br}_{2}$
They synthesised the complexes with identical molecular formula molar mass geometry conductane and spin but they differed in colour Based on the above facts answer the following questions

Complexes synthesised can be
(i) $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5}\left(\mathrm{NO}_{2}\right) \mathrm{Br}_{2}\right.$,(ii) $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5}(\mathrm{ONO})\right] \mathrm{Br}_{2}$
(iii) $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Br}_{2}\right] \mathrm{NO}_{2}$ (iv) All of these.
A. Both(i) and (ii)
B. Both(i) and(iii)
C. Both(ii)and(iii)
D. All of these

## Answer: A

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12. One cationic complex has to isomers $A$ and $B$ Each has one $\mathrm{Co}^{3+}$ five $\mathrm{NH}_{3}$ one $\mathrm{CI}^{\Theta}$ and one $\mathrm{SO}_{4}^{2-}$ stoichiometically A give white precipitate with $\mathrm{BaCI}_{2}$ white $B$ gives white precipitate with $\mathrm{AgNO}_{3}$

A can be .
A. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5}\right] \mathrm{CISO}_{4}$
B. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{SO}_{4}\right] \mathrm{CI}$
c. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{CI}\right] \mathrm{SO}_{4}$
D. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{SO}_{4}\right] \mathrm{CI} . \mathrm{NH}_{3}$

## Answer: C

## - Watch Video Solution

13. One cationic complex has to isomers $A$ and $B$ Each has one $\mathrm{Co}^{3+}$ five $\mathrm{NH}_{3}$ one $\mathrm{CI}^{\Theta}$ and one $\mathrm{SO}_{4}^{2-}$ stoichiometically A give white precipitate
with $\mathrm{BaCI}_{2}$ white B gives white precipitate with $\mathrm{AgNO}_{3}$
(B) can be .
A. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{SO}_{4}\right] \mathrm{CI}$
B. $\left[\mathrm{CO}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{CI}\right] \mathrm{SO}_{4}$
c. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{CI}\left(\mathrm{SO}_{4}\right)\right] 2 \mathrm{NH}_{3}$
D. None of these

## Answer: A

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14. Complexes $A$ and $B$ have similarity in the following but not in .
A. (a)Molar conductane
B. (b)Van't Hoff factor
C. (c)EAN
D. (d)Colour

## Answer: D

## D View Text Solution

15. Velence bond theroy describes the bonding in complexs in terms of coordinate -covalent bond resulting from overlap filled ligand orbitals with vacant metal hybrid orbitals This theory explains magnetic behaviour and geometrical shape of coordination compounds Magnetic moment of a complex compound can be determined experimentally and theoretically by using spin only formula

Magnetic moment $\sqrt{n}(n+2) B M$ (where $\mathrm{n}=$ No. unpaired electrons).
The value of of spin only magnetic moment for octahedral complex of the following configuration is $2.84 B M$ The correct statement is
(a) $d^{4}$ (in weak field ligand)
(b) $d^{2}$ (in weak field and in strong field ligand)
(c) $d^{3}$ (in weak field and in strong field ligand)
(d) $d^{5}$ (in strong field ligand).
16. Velence bond theroy describes the bonding in complexs in terms of coordinate -covalent bond resulting from overlap filled ligand orbitals with vacant metal hybrid orbitals This theory explains magnetic behaviour and geometrical shape of coordination compounds Magnetic moment of a complex compound can be determined experimentally and theoretically by using spin only formula

Magnetic moment $\sqrt{n}(n+2) B M$ (where $\mathrm{n}=$ No. unpaired electrons).
$\mathrm{Ni}^{2+}$ cation combines with a uninegative monodentate ligand $X^{\Theta}$ to form paramagnetic complex $\left[\mathrm{NiCI}_{4}\right]^{2-}$ The number of unpaired electrons(s) in central metal cation and geometry of this complex respectively are
(a) One,tetrahedral
(b) Two,tetrahedral
(c) One,square planar
(d) Two, square planar .
17. Give an example of displacement reaction.

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18. Square planar complexes are formed by $d^{8}$ ions with strong field ligands The crystal field splitting $\Delta_{0}$ is larger for the second and theird row transition elements and for more highly charged species All the complexes having $4 d^{8}$ and $5 d^{8}$ configurations are mostly square planar including those with weak field ligands such as halide ions square planar complexes can show geometrical isomerism but they do not show optical isomerism due to the presence of plane of symmetry

Among the following complexes which has a square planar geometry?
(a) $\left[\operatorname{RhCl}(C O)\left(P \mathrm{Ph}_{3}\right)_{2}\right]$
(b) $\mathrm{K}_{3}\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]$
(c ) $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$
(d) $K_{2}\left[\mathrm{Zn}(\mathrm{CN})_{4}\right]$.
19. Square planar complexes are formed by $d^{8}$ ions with strong field ligands The crystal field splitting $\Delta_{0}$ is larger for the second and theird row transition elements and for more highly charged species All the complexes having $4 d^{8}$ and $5 d^{8}$ configurations are mostly square planar including those with weak field ligands such as halide ions square planar complexes can show geometrical isomerism but they do not show optical isomerism due to the presence of plane of symmetry

Among the following complexes which has a square planar geometry?
(a) $\left[\operatorname{RhCl}(\mathrm{CO})\left(\mathrm{PPh}_{3}\right)_{2}\right]$
(b) $\mathrm{K}_{3}\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]$
(c ) $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$
(d) $K_{2}\left[\mathrm{Zn}(C N)_{4}\right]$.

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20. If in the mixed carbonyl the other ligand is also $\pi$ acceptor it would compete with the ligand $C O$ for gaining the metal $d_{\pi}$ electron charge The higher is the extent of back donation in $C O$, the lesser will be the
stretching vibration frequency for $\mathrm{C}-\mathrm{O}$ bond If $\mathrm{PP}_{3}$ is better pi-acceptor than CO then answer the following

Select the correct order of $M-C$ bond order in the following molecule and ions.
(I) $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$
(II) $\left[\mathrm{Co}(\mathrm{CO})_{4}\right]^{\Theta}$
(III) $\left[\mathrm{Fe}(\mathrm{CO})_{4}\right]^{2-}$
(a) I $>$ II $>$ III
(b) $I=I I=I I I$
(c) II $>$ III $>$ I
(d) $I<$ II $<$ III .

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21. If in the mixed carbonyl the other ligand is also $\pi$ acceptor it would compete with the ligand $C O$ for gaining the metal $d_{\pi}$ electron charge The higher is the extent of back donation in $C O$, the lesser will be the stretching vibration frequency for $\mathrm{C}-\mathrm{O}$ bond If $\mathrm{PP}_{3}$ is better pi-acceptor than $C O$ then answer the following

Select the correct order of stretaching vibration frequency $C$ - $O$ bond in following molecules
(I) $\left.[\mathrm{Ni}(\mathrm{CO}))_{4}\right]$
(II) $\left[\mathrm{Ni}\left(\mathrm{PF}_{3}\right)(\mathrm{CO})_{3}\right]$
(a) $I=I I$
$I<I I$
(c) $I=I I$
(d) cannot be predicated .

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22. If in the mixed carbonyl the other ligand is also $\pi$ acceptor it would compete with the ligand $C O$ for gaining the metal $d_{\pi}$ electron charge The higher is the extent of back donation in $C O$, the lesser will be the stretching vibration frequency for $\mathrm{C}-\mathrm{O}$ bond If $\mathrm{PP}_{3}$ is better pi-acceptor than CO then answer the following

Select the correct order of $C-O$ bond length in the following molecules .
(I) $\left[\mathrm{Mo}(\mathrm{CO})_{3}\left(\mathrm{PF}_{3}\right)_{3}\right](\mathrm{III})\left[\mathrm{Mo}(\mathrm{CO})_{3}\left(\mathrm{PCI}_{3}\right)_{3}\right]$
(III) $\left[\mathrm{Mo}(\mathrm{CO})_{3}\left(P(\mathrm{Me})_{3-}-(3)\right]\right.$
(a) $I>$ II $>$ III
(b) III $>$ I $>$ II
(c) II $>$ III $>$ I
(d) I $<$ II $<$ III

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23. Most of the metal carbonyls obey inert gas rule which states the the compounds in which the central metal atom appears to have attained the configuration of a noble gas either by the sharing or by the transfer of electrons tend to be more stable

Which of the following has highest $C-O$ bond length ?
(a) $\left[\mathrm{Mn}(\mathrm{CO})_{6}\right]^{\oplus}$
(b) $\left[\mathrm{Co}(\mathrm{CO})_{4}\right]^{\Theta}$
(c) $\left.\left[\mathrm{Fe}(\mathrm{CO})_{4}\right)\right]^{2-}$
(d) $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$.
24. If in the mixed carbonyl the other ligand is also $\pi$ acceptor it would compete with the ligand $C O$ for gaining the metal $d_{\pi}$ electron charge The higher is the extent of back donation in $C O$, the lesser will be the stretching vibration frequency for $\mathrm{C}-\mathrm{O}$ bond If $\mathrm{PP}_{3}$ is better pi-acceptor than $C O$ then answer the following

Select the correct order of $C-O$ bond length in the following molecules .
(I) $\left.\left[\mathrm{Mo}(\mathrm{CO})_{3}\left(\mathrm{PF}_{3}\right)_{3}\right] \mathrm{III}\right)\left[\mathrm{Mo}(\mathrm{CO})_{3}\left(\mathrm{PCI}_{3}\right)_{3}\right]$
(III) $\left[\mathrm{Mo}(\mathrm{CO})_{3}\left(P(\mathrm{Me})_{3}\right)\right]$
(a) I $>$ II $>$ III
(b) III $>$ I $>$ II
(c) II $>$ III $>$ I
(d) I $<$ II $<$ III

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25. Most of the metal carbonyls obey inert gas rule which states the the compounds in which the central metal atom appears to have attained the configuration of a noble gas either by the sharing or by the transfer of
electrons tend to be more stable

Which of the following has highest $C-O$ bond length ?
(a) $\left[m n(C O)_{6}\right]^{\oplus}$
(b) $\left[\mathrm{Co}(\mathrm{CO})_{4}\right]^{\Theta}$
(c) $\left.\left[\mathrm{Fe}(\mathrm{CO})_{4}\right)\right]^{2-}$
(d) $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$.

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26. In the manufacture of iron a gas $(A)$ is formed in the zone of combustion of the blast furnace The gad (A) formed in the zone of combustion of the blast furnace. The gas (A) reacted with coke in the zone of fusion to from another gas (B). $X$ moles of (B) reacts with iron at $200^{\circ} \mathrm{C}$ and 100 atm pressure to form a compounds ( $C$ ) will be The magnetic moment and effective atomic number of the $C$ repectively, are
(a) 4.93 and 36
(b) 0 and 34
(c) 0 and $36^{\circ}$
(d) None.

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27. In the manufacture of iron a gas $(A)$ is formed in the zone of combustion of the blast furnace The gad (A) formed in the zone of combustion of the blast furnace. The gas (A) reacted with coke in the zone of fusion to from another gas (B). $X$ moles of (B) reacts with iron at $200^{\circ} \mathrm{C}$ and 100 atm pressure to form a compounds ( $C$ ) will be The magnetic moment and effective atomic number of the $C$ repectively, are
(a) 4.93 and 36
(b) 0 and 34
(c) 0 and $36^{`}$
(d) None.

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28. The $\pi$ acceptor ligands are those which possess vacant $\pi$ - orbitals in addition to the lone pairs of electrons

Which of the following complex ion has lowest $M-C$ bond length?
(a) $\left[V(C O)_{6}\right]^{\oplus}$
(b) $\left.\left[M n(C O)_{6}\right]\right]^{\oplus}$
(c ) $\mathrm{Ni}(\mathrm{CO})_{4}$
(d) $\mathrm{Fe}(\mathrm{CO})_{5}$.

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29. The $\pi$ acceptor ligands are those which possess vacant $\pi$ - orbitals in addition to the lone pairs of electrons

Which of the following complex ion has the highest $C-O$ bond length ?
(a) $\left[V(C O)_{6}\right]^{\oplus}$
(b) $\mathrm{Ni}(\mathrm{CO})_{4}$
(c ) $\mathrm{Fe}(\mathrm{CO})_{5}$
(d) $\left[\mathrm{Mn}(\mathrm{CO})_{6}\right]^{\oplus}$.
30. The $\pi$ acceptor ligands are those which possess vacant $\pi$ - orbitals in addition to the lone pairs of electrons

Which of the following complex ion has lowest $M-C$ bond length?
(a) $\left[V(C O)_{6}\right]^{-}$
(b) $\left[\mathrm{Mn}(\mathrm{CO})_{6}\right]^{\oplus}$
(c ) $\mathrm{Ni}(\mathrm{CO})_{4}$
(d) $\mathrm{Fe}(\mathrm{CO})_{5}$.

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31. The $\pi$ acceptor ligands are those which possess vacant $\pi$ - orbitals in addition to the lone pairs of electrons

Which of the following complex ion has lowest $M-C$ bond length?
(a) $\left[V(C O)_{6}\right]^{-}$
(b) $\left[\mathrm{Mn}(\mathrm{CO})_{6}\right]^{\oplus}$
(c ) $\mathrm{Ni}(\mathrm{CO})_{4}$
(d) $\mathrm{Fe}(\mathrm{CO})_{5}$.

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32. The pi acid ligands donate their lone pairs to the metal to form a normal o bond with the latter in addition to it the vacant orbitals accepct electrons from the filled mental orbitals to form a type of pi bonand which suppliments the o bond

Which of the following has lowest $M-C$ bond lenght?
$\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$
(b) $\left[M n(C O)_{6}\right]^{\oplus}$
(c) $\left[\mathrm{Fe}(\mathrm{CO})_{4}\right]^{2-}$
(d) $\left[\mathrm{Co}(\mathrm{CO})_{4}\right]^{\Theta}$.

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33. The pi acid ligands donate their lone pairs to the metal to form a normal o bond with the latter in addition to it the vacant orbitals accepct electrons from the filled mental orbitals to form a type of pi bonand which suppliments the o bond

Which of the following has highest $M-C$ bond lenght?
$\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$
(b) $\left[M n(C O)_{6}\right]^{\oplus}$
(c) $\left[\mathrm{Fe}(\mathrm{CO})_{4}\right]^{2-}$
(d) $\left[\mathrm{Co}(\mathrm{CO})_{4}\right]^{\Theta}$.
34. On a frictionless horizontal surface, assumed to be the $x-y$ plane , a small trolley $A$ is moving along a straight line parallel to the $y$-axis ( see figure) with a constant velocity of $(\sqrt{3}-1) \mathrm{m} / \mathrm{s}$. At a particular instant, when the line $O A$ makes an angle of 45( $\circ$ ) with the $x$ - axis, a ball is thrown along the surface from the origin $O$. Its velocity makes an angle $\phi$ with the $x$ - axis and it hits the trolley .
(a) The motion of the ball is observed from the frame of the trolley .

Calculate the angle $\theta$ made by the velocity vector of the ball with the $x$ axis in this frame .
(b) Find the speed of the ball with respect to the surface, if $\phi=(4 \theta) /(3)$.


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35. Coordination compounds plays many important roles in animals and plants. The are essential in the storage and transport of oxygen as electrons transfer agents as catalysts and in photosynthesis Wide range of application in daily life takes place through formation of complexes Photographic fixing qualitative and quantitative analysis purification of water metallurgical extraction are some specific worth mentioning The complex $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{5} \mathrm{NO}\right]^{2+}$ is formed in the brown ring test for nitrates when freshly prepared $\mathrm{FeSO}_{4}$ soultion is added to aqueous solution of $\mathrm{NO}_{3}^{\Theta}$ followed by addition of conc. $\mathrm{H}_{2} \mathrm{SO}_{4}$ Select correct statement about this complex
(a) Colour change is due to charge transfer
(b) It has iron in +1 oxidation state and nitrosyl as $\mathrm{NO}^{\oplus}$
(c) It has magnetic moment of $3.87 B M$ confirming three unpaired electrons in Fe
(a) All the above are correct statements .

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36. Coordination compounds plays many important roles in animals and plants. The are essential in the storage and transport of oxygen as electrons transfer agents as catalysts and in photosynthesis Wide range of application in daily life takes place through formation of complexes Photographic fixing qualitative and quantitative analysis purification of water metallurgical extraction are some specific worth mentioning Extraction of Ag from sulphide ore and removal of unreacted silver from photographic plate involve complexes:
(a) $\left[\mathrm{Ag}\left(\mathrm{S}_{2} \mathrm{O}_{3}\right)_{2}\right]^{3-}$ ion both
(b) $\left[A g(C N)_{2}\right]^{\Theta}$ in both
(c) $\left[\mathrm{Ag}\left(\mathrm{S}_{2} \mathrm{O}_{3}\right)\right]^{3-},\left[\mathrm{Ag}(\mathrm{CN})_{2}\right]^{\Theta}$
(d) $\left[A g(C N)_{2}\right]^{\Theta},\left[\text { Ag_( }_{-}(2)\left(\mathrm{S}_{-}(2) \mathrm{O}_{-}(3)\right)_{-}(2)\right]^{\wedge}(3-)^{\wedge}$.

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37. Coordination compounds plays many important roles in animals and plants. The are essential in the storage and transport of oxygen as electrons transfer agents as catalysts and in photosynthesis Wide range
of application in daily life takes place through formation of complexes Photographic fixing qualitative and quantitative analysis purification of water metallurgical extraction are some specific worth mentioning Lead poisoning in the body can be removed by
(a) EDTA in the form of calcium dthydrogen salt
(b) Cis-platin
(c) Zeisse' s salt
(d) $D M G$.

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38. Arrange the following in order of decreasing number of unpaired electrons :
i. $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}_{6}\right)\right]^{2+}$
ii. $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{3-}$
iii. $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{4-}$
iv. $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$

## Exercises Multiple Correct(Naming And Terminology)

1. Selcet the correct statement(s) for double salt .
A. Double salts are stable in solid state but lose their identity in aqueous solution .
B. In double salt the properties of constituent ions are not changed in their aqueous solution .
C. Double salts are stable in solid state and do not lose their identity in aqueous solution.
D. In double salt the properties of constituent ions are changed in their aqueous solution .

## Answer: A: B

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2. Which of the following ligand (s) is/are ambidentate ?
A. $\operatorname{NOS}^{\Theta}$
B. $S C N^{\Theta}$
C. $\mathrm{NO}_{2}{ }^{\Theta}$
D. $\mathrm{CH}_{3} \mathrm{COO}^{\Theta}$

## Answer: A::B::C

## D Watch Video Solution

3. Select the correct IUPA name for $\left[\mathrm{CoCI}_{2}(\text { en })_{2}\right]_{2}\left(\mathrm{CIO}_{3}\right)_{2}$.
A. Dichloridobis (ethylenediamine)cobalt(III)chlorate .
B. Dichloridobis (ethane-1,2-diamine)cobalt(III)chlorate .
C. bis\{dichloridoethylenediaminecobalt(III)\}chlorate
D. bis\{di(chlorido)ethylenediaminecobalt(III)\}chlorate

## D Watch Video Solution

4. Bidentate ligands are
A. $\mathrm{C}_{2} \mathrm{O}_{4}^{2-}$ (oxalate)
B. en(ethylenediamine)
C. $D M G$ (dimethyl glyoxime)
D. Gly (glycine)

## Answer: A::B::C::D

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5. Which of the following complex (s) is/are having correct name ?
A. $\mathrm{Cs}\left[\mathrm{Pt}\left(\mathrm{NH}_{3}\right) I_{5}\right]$ Ceasium amminepentaiodidoplatirate(IV)
B. $\left[\mathrm{Ag}(\mathrm{CN})_{2}\right]^{\Theta}$ Dicyanidoargentate(I)ion
C. $\left[\operatorname{Rb}\left[\operatorname{Cr}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{3}\right]\right.$-Rubidium trioxalatochromate(III)
D. $K_{2}[\mathrm{Ni}(E D T A)]$ Potassium ethylenediaminetetraacetatonickel(II)

## Answer: A::B::C

## - Watch Video Solution

6. Which can form chelates?
A. Ethylene diamine
B. Oxalate
C. Glycinate
D. Cyanide

## Answer: A::B::C

7. Select the correct IUPAC name for the following

A. Tetramminecobalt(III)muamido-mu-
peroxidotetraamminedicobalt(III) ion
B. mu-Amido-mu-peroxidobis(tetraammine)dicobalt-(III)ion
C. mu-Amido-mu-peroxidobis(tetraamminecobalt(III))ion
D. mu-Amido-mu-peroxidobis(tetraamminecobalt(III))ion

## Answer: A::B::C::D

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8. Which of the following statement(s) is//are correct?
A. Primary valency of the central metal of a complex is always satisfied by anions.
B. Secondary valency of the central metal of a complex may be satisfied by either negative ions or neutral molecules .
C. Species which show primary valencies in a complex compound can be precipitated out .
D. None of these

## Answer: A::B::C

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9. Which of the following complex(s)is//are an example of homolepic complex.
A. a) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$
B. b) $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$
C. c) $\left[\mathrm{Ni}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$
D. $d)\left[\mathrm{Ni}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right]$

## Answer: A::B::C

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## Exercises Multiple Correct(Isomerism )

1. Which of the following molecules(s)is/are not showing optical isomerism?.
A. a. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{Cl}\right] \oplus$
B. b. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$
C. c. $\left[\mathrm{Zn}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$
D. d. $\left[\mathrm{Sc}\left(\mathrm{H}_{2} \mathrm{O}\right)_{3}\left(\mathrm{NH}_{3}\right)_{3}\right]^{3+}$

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2. Which of the following complex ions is not expected to absorb visible light?
A. a. $\left[\operatorname{Ti}(e n)_{2}\left(\mathrm{NH}_{3}\right)_{2}\right]^{4+}$
B. b. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$
c. c. $\left[\mathrm{Zn}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$
D. d. $\left[\mathrm{Sc}\left(\mathrm{H}_{2} \mathrm{O}\right)_{3}\left(\mathrm{NH}_{3}\right)_{3}\right]^{3+}$

## Answer: A::C::D

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3. Coordination compounds plays many important roles in animals and plants. The are essential in the storage and transport of oxygen as electrons transfer agents as catalysts and in photosynthesis Wide range
of application in daily life takes place through formation of complexes Photographic fixing qualitative and quantitative analysis purification of water metallurgical extraction are some specific worth mentioning

The complex $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{5} \mathrm{NO}\right]^{2+}$ is formed in the brown ring test for nitrates when freshly prepared $\mathrm{FeSO}_{4}$ soultion is added to aqueous solution of $\mathrm{NO}_{3}^{\Theta}$ followed by addition of conc. $\mathrm{H}_{2} \mathrm{SO}_{4}$ Select correct statement about this complex
(a) Colour change is due to charge transfer
(b) It has iron in +1 oxidation state and nitrosyl as $\mathrm{NO}^{\oplus}$
(c ) It has magnetic moment of $3.87 B M$ confirming three unpaired electrons in Fe
(a) All the above are correct statements .
A. Colour change is due to charge transfer .
B. It has iron in +1 oxidation state and nitrosyl as $N O^{\oplus}$.
C. It has magnetic moment of $3.87 B M$ confirming three unpaired electrons in Fe .
D. In complex Fe has $d^{2} s p^{3}$ hybridisation .

## D Watch Video Solution

4. Which of the following represent the correct sequence of indicated property?.
A. $a . \mathrm{Mn}^{2+}<\mathrm{Ni}^{2+}<\mathrm{Co}^{2+}<\mathrm{Fe}^{2+}$ : magnetic moment
B. $b . \mathrm{FeO}>\mathrm{CoO}>\mathrm{NiO}$ :basic character
C. c. $\mathrm{Sc}<\mathrm{Ti}<\mathrm{Cr}<\mathrm{Mn}$ : number of oxidation states
D. d.1.73 $\mu$ : one unpaired electrons

## Answer: B::C::D

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5. Which of the following complexes diamagnetic:
A. $\left[A u I_{4}\right]^{\Theta}$
B. $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$
C. $\left[\mathrm{CoI}_{6}\right]^{3-}$
D. $\left[\mathrm{Co}(\mathrm{CO})_{4}\right]^{\Theta}$

## Answer: A::D

## - Watch Video Solution

6. Which of the following molecules will not show optical activity ?
A. a. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{Br}_{3}\right]$
B. b. $\left[\mathrm{Co}(e n) \mathrm{Br}_{2}\left(\mathrm{NH}_{3}\right)_{2}\right]^{\oplus}$
C. c. $\left[\mathrm{Co}(\mathrm{en})_{3}\right]^{3+}$
D. d. $\left[\mathrm{Co}(e n)_{2} \mathrm{Br}_{2}\right]^{\oplus}$

## Answer: B::C::D

7. Both geometrical and optical isomerism are shown by
A. a.dibromidobis (ethylenediamine)cobalt(III)ion
B. b.tetraamminedibromido cobalt(III)ion
C. c.tetraamminedibromido cobalt(III) ion
D. d.trioxalatochromate(III)ion

## Answer: B::C::D

## - Watch Video Solution

8. Which of the following statement(s) is/are correct?
A. a.The complexes $\left[\mathrm{NiCl}_{4}\right]^{2-}$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ differ in state of hybridisation of nickyl.
B. b.The complexes $\left[\mathrm{NiCl}_{4}\right]^{2-}$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ differ in geometry .
C. c.The complexes $\left[\mathrm{NiCl}_{4}\right]^{2-}$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ differ in the magnetic properties.
D. d.The complexes $\left[\mathrm{NiCl}_{4}\right]^{2-}$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ differ in primary valencies of nickel.

## Answer: A::B::C

## - Watch Video Solution

9. In Which case gemetrical isomer cis is possible with $M$ as metal ion if complexes are square planar having $C N=4$ ?
A. a. $M X_{2} Y_{2}$
B. b. $M X_{2} Y Z$
C. c. $M X Y_{2} Z$
D. d. $M X_{4}$
10. $d_{x} 2-y^{2}$ orbital is involved in which of the following hybridisation ?
A. $a . s p^{3} d^{3}$
B. b. $d s p^{2}$
C. c. $s p^{3} d^{2}$
D. d. $s p^{3} d$

## Answer: B::C

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## Exercises Multiple Correct (Hybridisation , Vbt , Cft )

1. A d-block element forms octahedral complex but its magnetic moment remains same either in strong field or in weak field ligand. Which of the following is/are correct?
A. a.Element always forms colourless comound
B. b.Number of electrons in $t_{2 g}$ orbitals are higher than in $e_{g}$ orbitals
C. c.It can have either $d^{3}$ or $d^{8}$ configuration.
D. d.It can have either $d^{7}$ or $d^{8}$ configuration

## Answer: B::C

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2. Which of the following is//are characteristic of a tetrahedral complex ?
A. a. $d_{x} 2-y^{2}$ and $d_{z}^{2}$ orbitals are low energy orbitals
B. b.Most tetrahedral complexes are high spin
C. c.Crystal field splitting is found double in octahedral complexes .
D. d.Splitting pattern in tetrahedral complex is just opposite of that in octahedral complexes.
3. The complex $K_{4}\left[\mathrm{Zn}(\mathrm{CN})_{4}\left(\mathrm{O}_{2}\right)_{2}\right]$ is oxidised into $\mathrm{K}_{2}\left[\mathrm{Zn}(\mathrm{CN})_{4}\left(\mathrm{O}_{2}\right)\right]$, then whichof the following is//are correct:
A. a.Zn(II) is oxidised to $\mathrm{Zn}(\mathrm{IV})$
B. b.magnetic moment decreases
C. c.O-O bond length decreases
D. d.magnetic moment remains same.

## Answer: C::D

## - Watch Video Solution

4. Select the correct statement:
A. a. $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$ is $\mathrm{Co}(\mathrm{III})$, low spin, O unpaired electrons diamagnetic.
B. b. $\left[\mathrm{CoF}_{6}\right]^{3-}$ is $\mathrm{Co}(\mathrm{III})$, high spin $d^{6}, 4$ unpaired electron paramagnetic.
C. c. $\left[R h F_{6}\right]^{3-}$ is $R h(I I I)$ low spin $d^{6}, 0$ unpaired eletrons diamagnetic .
D. d. $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{4-}$ high spin $d^{6}, 0$ unpaired electron dimagentic .

## Answer: A::C::D

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5. $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$ complex is
A. a.High spin complex
B. b.Having $d^{2} s p^{3}$-hybridization
C. c.Low spin complex
D. d.Having octahedral structure .

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6. Colourless tetrahedral complexes among the following are
A. a. $K_{3}\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]$
B. b. $\mathrm{Ca}\left[\mathrm{NiCI}_{4}\right]$
C. c. $\mathrm{Na}\left[\mathrm{BF}_{4}\right]$
D. d. $\mathrm{Ni}(\mathrm{CO})_{4}$

## Answer: A::C::D

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Exercises Multiple Correct(Application Of Coordination Compounds)

1. The coordination number of a central metal atom in a complex(s) is//are not determined by
A. a.The number of anionic ligands bonded to the metal ion
B. b.The number of ligands around metal ion bonded by pi-bonds
C. c.The number of ligands around a metal ion bonded by both pi and
o-bonds
D. d.The number of ligands around a metal ion bonded by o-bonds

## Answer: A::B::C

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2. which of the following statements is/are incorrect?
A. Metal carbonyls are the examples of only o-boned organometallic complexes
B. Metal carbonyls are the examples of only o-boned organometallic complexes
C. Metal carbonyls are the examples of only o-boned organometallic complexes which involve both o and pi-bonds between metal and carbon of the carbonyl group .
D. Metal carbonyls involve both $o$ and $\pi$ bonds between metal and oxygen of the carbonyl group .

## Answer: A::B::D

## D Watch Video Solution

3. Which of the folowing is an example of $\pi$ boneded organometallic complex ?
A. Ferrocene
B. Dibenzenechromium
C. $\mathrm{Zn}\left(\mathrm{C}_{2} \mathrm{H}_{5}\right)_{2}$
D. $\mathrm{Pb}\left(\mathrm{C}_{2} \mathrm{H}_{5}\right)_{4}$

## Answer: A: B

## - Watch Video Solution

4. Which of the following is/are example (s) of o-bonded organometallic compound?
A. $\mathrm{Al}_{2}\left(\mathrm{CH}_{3}\right)_{6}$
B. $\mathrm{Pb}\left(\mathrm{CH}_{3}\right)_{4}$
C. $\mathrm{Zn}\left(\mathrm{C}_{2} \mathrm{H}_{5}\right)_{2}$
D. Ferrocene

## Answer: A::B::C

5. Which of the following statement is correct regarding metal carbonyl ?
A. a.In $M n_{2}(C O)_{10}$ bond order of $M n-M n$ is 0 .
B. b.In $\mathrm{Fe}_{2}(\mathrm{CO})_{9}$ number of $\mathrm{Fe}-\mathrm{Fe}$ bonds is 1
C. c.In $\mathrm{Ni}(\mathrm{CO})_{4}$ all bond length are same
D. d. $\mathrm{Fe}(\mathrm{CO})_{5}$ is diamagnetic

## Answer: B::C::D

## - Watch Video Solution

6. Select correct statements:
A. a. $\left[\mathrm{Ni}(e n)_{3}\right]^{2+}$ is less stable than $\left[\mathrm{Ni}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$
B. b.Increase in stability of the complexes due to the presence of multidentate cyclic ligand is called macro-cyclic effect .
C. c. $\left[\mathrm{Ni}(e n)_{3}\right]^{2+}$ is more stable than $\left[\mathrm{Ni}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$
D. d.For a given ion and ligand the greater the charge on the metal ion the greater is the stability

## Answer: B::C::D

## - Watch Video Solution

7. Which of the following involves synergic bonding?
A. $\left[\operatorname{PtCI}_{3}\left(\mathrm{C}_{2} \mathrm{H}_{4}\right)\right]^{\Theta}$
B. $\left[N i\left(P F_{3}\right)_{4}\right]$
C. $C r\left[\left(C_{6} H_{6}\right)_{2}\right]$
D. $\mathrm{Fe}\left[\left(\pi-\mathrm{C}_{5} \mathrm{H}_{5}\right)_{2}\right]$

## Answer: A::B::C

## - Watch Video Solution

8. Which of the following statement(s) is/are correct?
A. The stability constant of $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$ is larger than that of $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$
B. The cyano complexes more stable than those formed by halide ions
C. The stability of halide complexes follows the order $I^{\Theta}>\mathrm{Br}^{\Theta}>\mathrm{CI}^{\Theta}>\mathrm{F}^{\Theta}$.
D. The stability constant of $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$ is less than that of $\left[\mathrm{CuCI}_{4}\right]^{2-}$.

## Answer: A::B

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Exercises Single Correct (Naming And Terminology)

1. Select the correct IUPAC name for

$$
\left[T i\left(\pi-C_{5} H_{5}\right)_{2}\left(O-C_{5} H_{5}\right)_{2}\right] .
$$

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2. Select the correct IUPA name of
$\left[\mathrm{Mo}\left(\sigma-\mathrm{C}_{3} \mathrm{H}_{5}\right)\left(\pi-\mathrm{C}_{5} \mathrm{H}_{5}\right)\left(\mathrm{CO}_{3}\right)\right]$.
A. Tricarbonyl ( $\eta^{5}$-cyclopentadinenyl) ally1 molybdate(II) .
B. Allytricarbonyl ( $\eta^{5}$-cyclopentadiene)molybdate(II)
C. Allytricarbonyl ( $\eta^{5}$-cyclopentadiene)molybdate(II)
D. Allytricarbonyl ( $\eta^{5}$-cyclopentadiene)molybdate(II)

## Answer: D

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3. IUPAC name for $\left[\mathrm{Fe}(\mathrm{CO})_{2}\left(\sigma-\mathrm{C}_{5} \mathrm{H}_{5}\right)\left(\pi-\mathrm{C}_{5} \mathrm{H}_{5}\right)\right]$ complex :
A. Dicarbony1 ( $\eta^{5}$-cyclopentadieny1)(cyclopentadieny1) ferrate(II)
B. Dicarbony1 ( $\eta^{5}$-cyclopentadieny1)(cyclopentadieny1) iron(II)
C. Dicarbony1 ( $\eta^{5}$-cyclopentadieny1)(cyclopentadieny1) iron(II)
D. Dicarbony1 ( $\eta^{5}$-cyclopentadieny1)(cyclopentadieny1) iron(II)

## Answer: A

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4. Select the correct IUPA name for $\left[\mathrm{Cr}\left(\mathrm{C}_{6} \mathrm{H}_{6}\right)(\mathrm{CO})_{3}\right]$.
A. ( $\eta^{6}$ benzene) tricarbonylchromate( 0 )
B. Tricarbony1 ( $\eta^{6}$ benzene) tricarbonylchromate(0)
C. Tricarbony1 ( $\eta^{6}$ benzene) tricarbonylchromium( 0 )
D. ( $\eta^{6}$ benzene) tricarbonylchromium( 0 )

## Answer: D

5. IUPAC name for complex $\left[\mathrm{Mn}\left(\pi-\mathrm{C}_{6} \mathrm{H}_{5}\right)(\mathrm{CO})_{3}\right]$ :
A. Tricarbonyl ( $\eta^{5}$-cyclopentadiene)manganes(I)
B. Tricarbonyl ( $\eta^{5}$-cyclopentadiene)manganes(I)
C. Tricarbonyl ( $\eta^{5}$-cyclopentadiene)manganes(I)
D. $\left(\eta^{5}\right.$-cyclopentadiene) manganes(I)

## Answer: C

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6. Ligand with two or more points of attachment to single metal atoms are called .
A. Monodentate ligand
B. Chelating ligand
C. Ambidentate ligand
D. None of these

## Answer: B

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7. The number of ions produced by the complex $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right] \mathrm{CIO}_{3}$ is .
A. 2
B. 3
C. 4
D. 6

## Answer: A

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8. Which of the following is a tridentate ligand?
A. $N O_{2}^{\Theta}$
B. Oxalate ion
C. Glycinate ion
D. Dien

## Answer: D

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9. Coordination number of calcium is six in .
A. $[M g(E D T A)]^{2-}$
B. $\mathrm{MgC}_{2} \mathrm{O}_{4}$
C. $\mathrm{Mg}\left[\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{2}\right]^{2-}$
D. $\mathrm{MgSO}_{4} \cdot 4 \mathrm{H}_{2} \mathrm{O}$

Answer: A
10. Coordination number of $\mathrm{Cu}^{2+}$ in $\mathrm{CuSO}_{4} \cdot 5 \mathrm{H}_{2} \mathrm{O}$ is .
A. 5
B. 4
C. 3
D. 2

## Answer: B

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11. The colsed ring compounds formed by bidentate ligands on binding to a metal or metal ions are called.
A. MoNodentate
B. Chelates
C. Ambidentate
D. None of these

## Answer: B

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12. Which is the pair of ambidentate ligand?
A. $\mathrm{CN}^{-}, \mathrm{NO}_{2}^{-}$
B. $\mathrm{NO}_{3}^{-}, \mathrm{SCN}^{-}$
C. $\mathrm{N}_{3}^{-}, \mathrm{NO}_{2}^{-}$
D. $\mathrm{NCS}^{-}, \mathrm{C}_{2} \mathrm{O}_{4}^{2-}$

## Answer: A

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13. Number of water molecules acting as ligands in $\mathrm{CuSO}_{4} \cdot 5 \mathrm{H}_{2} \mathrm{O}, \mathrm{ZnSO}_{4} \cdot 5 \mathrm{H}_{2} \mathrm{O}, \mathrm{FeSO}_{4} \cdot 7 \mathrm{H}_{2} \mathrm{O}$ respectively are .
A. 5, 5, 7
B. $4,5,4$
C. $4,4,6$
D. 4, 4, 7

## Answer: C

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14. Select the correct IUPA name for
$\left[P t\left(C_{5} H_{5} \mathrm{~N}\right)_{4}\left[\left[\mathrm{PtCI}_{4}\right]\right.\right.$ complex
A. Tetrapyridineplatinate(II)tetrachloridoplatinate(II)
B. Tetrapyridineplatinate(II)tetrachloridoplatinate(II)
C. Tetrapyridineplatinate(II)tetrachloridoplatinate(II)
D. Tetrapyridineplatinum(II)tetrachloridoplatinate(II)

## Answer: D

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15. Select the correct IUPAC name of $\left[\mathrm{C}_{4} \mathrm{H}_{4} \mathrm{Fe}(\mathrm{CO})_{3}\right]$ complex .
A. $\eta^{4}$-cyclebutadiene tricarbonyliron (0)
B. Tricarbonyl ( $\eta^{4}$-cyclobutadienyl) iron(0)
C. Tricarbonyl ( $\eta^{4}$-cyclobutadienyl) iron(1)
D. Tricarbonyl ( $\eta^{4}$-cyclobutadienyl) iron(0)

## Answer: D

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16. Oxidation state of " V " in $R b_{4} \mathrm{~K}\left[\mathrm{HV}_{10} \mathrm{O}_{28}\right]$ is .
A. +5
B. +6
C. $+\frac{7}{5}$
D. +4

## Answer: A

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17. Coordination number of Cr is six A complex with $\mathrm{C}_{2} \mathrm{O}_{4}^{2-}$ en and superoxide $\mathrm{O}_{2}$ will be in the ration to make complex

$$
\left[\mathrm{Cr}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{x^{\prime}}(e n)_{y}\left(\mathrm{O}_{2-}(\mathrm{z})\right]^{\Theta}\right.
$$


$\begin{array}{lll}x & y & z\end{array}$
C.

122
D. $\begin{array}{lll}x & y & z \\ 2 & 1 & 1\end{array}$

## Answer: D

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18. The compound $\left[\mathrm{CoCI}_{3} I\left(\mathrm{C}_{5} \mathrm{H}_{5} \mathrm{~N}\right)_{2}\right] \mathrm{Br}$ will show the chemical test for which of the following ions? .
A. $B r^{\Theta}$
B. $C I^{\Theta}$
C. $I^{\Theta}$
D. $B r^{\Theta}$ as well as $C I^{\Theta}$

## Answer: A

19. The correct IUPAC name of $\left[\mathrm{Mn}_{3}(\mathrm{CO})_{12}\right]$ is .
A. Dodecacarbonylmanganate(0)
B. Dodecacarbonylmanganate(II)
C. Dodecacarbonylmanganate(0)
D. Manganiododecarbonyl(0)

## Answer: C

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20. The correct name of

A. Tri-mu-carbonylbis(tricarbonyl)iron(0))
B. Hexacarbonyliron(III)mu-tricarbonylferrate(0)
C. Tricarbonyliron(0)mu-tricarbonyliron(0)
D. Nonacarbonyl iron

## Answer: A

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21. The correct IUPA name of $\left[\mathrm{AICI}_{3}\right] \cdot 4(\mathrm{EtOH})$ is .
A. Aluminium(II) chloride-4-ethanol
B. Trichloridoaluminium(III)-4-ethaol
C. Aluminium(III)chloride-4-hydroxyethane
D. Aluminium chloride-4-ethanol

## Answer: B

22. In octaamine $-\mu$-dihydroxodiiron(III)sulphate the number of bridging ligands is
A. 2
B. 1
C. 3
D. None

## Answer: A

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23. The IUPA name of the complex having formula $\left.[\mathrm{CO})_{3} \mathrm{Fe}(\mathrm{CO})_{3} \mathrm{Fe}(\mathrm{CO})_{3}\right]$ is.
A. Monocarbonylferrate(0)
B. Tricarbonyliron(0) - $\mu$-tricarbonyliron(0)
C. Tri- $\mu$ carbonylbis-\{tricarbonyliron(0) $\}$
D. Hexacarbony1 '-mu-tricarbonyliron(III)

## Answer: C

## - Watch Video Solution

24. A group of atoms can funcation as a ligand only when .
A. a.It is a small molecule
B. b.lt is capable of acting as donor of electron pair
C. c.it is a negatively charged ion
D. d.It is a positively charged ion .

## Answer: B

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25. Which one is the most likely structure of $\mathrm{CrCl}_{3} \cdot 6 \mathrm{H}_{2} \mathrm{O}$ if $1 / 3$ of total chlorine of the compound is precipitated by adding $\mathrm{AgNO}_{3}$ to its aqueous solution ?
A. $\mathrm{CrCI}_{3} \cdot 6 \mathrm{H}_{2} \mathrm{O}$
B. $\left.\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)\right)_{3} \mathrm{CI}_{3}\right]\left(\mathrm{H}_{2} \mathrm{O}\right)_{3}$
C. $\left[\mathrm{CrCI}_{2}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4}\right] C \mathrm{CI} 2 \mathrm{H}_{2} \mathrm{O}$
D. $\left[\mathrm{CrCI} .\left(\mathrm{H}_{2} \mathrm{O}\right)_{5}\right] \mathrm{CI}_{2} \cdot \mathrm{H}_{2} \mathrm{O}$

## Answer: C

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26. The coordination number of a central ion may be obtained from
A. a.The number of only anionic bonds formed with the surrounding ions
B. b.The number of coordinate bonds formed with the surrounding atoms
C. c.The number of ions of opposite charge immediately surrounding the specific ion .
D. d.None of the above

## Answer: D

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27. Which of the following is nonionisable?
A. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{CI}_{3}\right]$
B. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right] \mathrm{CI}$
c. $\left[\mathrm{Co}\left(\mathrm{Nh}_{3}\right)_{5} \mathrm{CI}\right] \mathrm{CI}_{2}$
D. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right] \mathrm{CI}_{3}$

## D Watch Video Solution

28. Which of the following pair contains complex salt and double salt respectively?
A. $\mathrm{FeSO}_{4}, \mathrm{~K}_{4}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$
B. $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right] \mathrm{SO}_{4}, \mathrm{FeSO}_{4} \cdot 7 \mathrm{H}_{2} \mathrm{O}$
C. $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right] \mathrm{SO}_{4}, \mathrm{~K}_{2} \mathrm{SO}_{4} \mathrm{Al}_{2}\left(\mathrm{SO}_{4}\right)_{3} \cdot 24 \mathrm{H}_{2} \mathrm{O}$
D. $\mathrm{MgSO}_{4} \cdot 7 \mathrm{H}_{2} \mathrm{O}, \mathrm{CuSO}_{4} \cdot 5 \mathrm{H}_{2} \mathrm{O}$

## Answer: C

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29. In Which of the following compunds the metal is in the lowest oxidation state?
A. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Br}\right] \mathrm{SO}_{4}$
B. $\mathrm{Fe}_{3}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]_{2}$
C. $\left[\mathrm{Mn}_{2}(\mathrm{CO})_{10}\right]$
D. $K\left[P_{t C I}^{3}\left(C_{2} H_{4}\right)\right]$

Answer: C

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30. Which of the following can be termed as mixed complex? .
A. a. $K_{4}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$
B. b. $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right] \mathrm{SO}_{4}$
C. c. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{NO}_{2} \mathrm{CI}\right] \mathrm{CI}$
D. d. $\mathrm{K}_{2} \mathrm{FeSO}_{4}$

## Answer: C

## Exercises Single Correct (Isomerism)

1. Among the following select the order of decreasing EAN valuse
$\left[\operatorname{cr}(C O)_{6}\right]$
(II) $\left[\operatorname{Cr}(\mathrm{CO})_{6}\right]^{\Theta}$
(III) $\left[\mathrm{Cr}(\mathrm{CO})_{6}\right]^{\oplus}$
A. $I>$ II $>$ III
B. III $>$ II $>$ I
C. 'llgtlgtIII
D. IIIIgtIII

## Answer: C

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2. Increasing order EAN of the metals in $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$
(II) $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{3-}$
(III) $\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]^{3-}$ is .
A. $I<$ II $<$ III
B. $I<I I=I I I$
C. I $<$ III $<$ II
D. III $<$ II $<$ I

## Answer: A

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3. EAN of na $\left[\operatorname{PtCI}_{3}\left(\eta^{2}-\mathrm{C}_{2} \mathrm{H}_{2}\right)\right]$ is .
A. 86
B. 78
C. 84
D. 34

## Answer: C

## - Watch Video Solution

4. EANof $\left[\mathrm{Fe}\left(\eta^{5}-\mathrm{C}_{5} \mathrm{H}_{5}\right)(\mathrm{CO})_{2} \mathrm{CI}\right]$ :
A. 36
B. 35
C. 37
D. 34

## Answer: A

5. Which has maximum EAN of the underbold atoms?
$(C r=24, C o=27, F e=26, N i=28)$.
A. a. $[\operatorname{Cr}(E D T A)]^{\Theta}$
B. b. $\left[\mathrm{Co}(e n)_{3}\right]^{3+}$
C. c. $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$
D. d. $\left[\mathrm{Fe}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{3}\right]^{3-}$

## Answer: B

6. Give $E A N$ value of Mg in $[M g(E D T A)]^{2-}$.
A. 16
B. 20
C. 22
D. 18

## Answer: C

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7. EAN of cobalt is 36 in $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2} \mathrm{O}_{2}(e n) b r\right]$ Thus $\mathrm{O}_{2}$ is .
A. dioxide
B. superoxide ion
C. peroxide ion
D. oxide

## Answer: C

## - Watch Video Solution

8. $E A N$ of Fe in $\left[\mathrm{Fe}\left(\mathrm{C}_{2} \mathrm{O}_{4-} \text { (3) }\right]^{3-}\right.$ is .
A. 27
B. 24
C. 35
D. 29

## Answer: C

## - Watch Video Solution

9. The $E A N$ of Fe atom in `

$$
\begin{gathered}
(\mathrm{CO})_{3} \mathrm{Fe}-\mathrm{Fe}(\mathrm{CO})_{3} \\
(\mathrm{CO})_{3}
\end{gathered}
$$

A. 34
B. 35
C. 36
D. 37

## Answer: C

## - Watch Video Solution

10. The complexes $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]\left[\mathrm{Cr}(\mathrm{CN})_{6}\right]$ and $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]\left[\mathrm{Co}(\mathrm{CN})_{6}\right]$ are the examples of which type of isomerism?
A. Linkage isomers
B. Ionisation isomers
C. Coordination isomers
D. None of these
11. The Type of isomerism present in pentaammine nitro chromium(III) perchlorate is .
A. Optical
B. Linkage
C. Hydrate
D. Polymerisation

## Answer: B

## - Watch Video Solution

12. Which one of the following has largest number of isomers ? $(R=$ alkyl group , en = ethylenediamine)
A. a. $\left[\mathrm{Cr}(e n)_{2} \mathrm{Cl}_{2}\right]^{\oplus}$
B. b. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Cl}\right]^{2+}$
C. c. $\left[\mathrm{Ru}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{Cl}_{2}\right] \oplus$
D. d. $\left[\operatorname{Ir}\left(\mathrm{PR}_{3}\right)_{2}(\mathrm{CO})_{2}\right]^{2+}$

## Answer: A

## - Watch Video Solution

13. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{NO}_{2}\right] \mathrm{SO}_{4}$ and $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{ONO}\right] \mathrm{SO}_{4}$ are related to each other as: .
A. Geometrical isomers
B. Linkage ismomers
C. Coordination isomers
D. Ionisation ismers

## Answer: B

14. Which one of the following will be able to show geometrical isomerism if complexes are square planar? .
A. $\mathrm{Ma}_{4}$
B. $M a_{3} b$
C. Mabcd
D. $\left[M(A A)_{2}\right]$

## Answer: C

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15. The number of geometrical and optical isomers of $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{3}\left(\mathrm{NO}_{3}\right)_{3}\right]$ is .
A. 3
B. 2
C. 0
D. 4

## Answer: B

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16. Both geometrical and optical isomerism are shown by
A. a. $\left[\mathrm{Co}(e n)_{2} \mathrm{Cl}_{2}\right]^{\oplus}$
B. b. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2} \mathrm{Cl}_{4}\right]-$
C. c. $\left[\mathrm{Co}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{3}\right]^{3-}$
D. d. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{Cl}_{2}\right]^{\oplus}$

## Answer: A

## D Watch Video Solution

17. $\left[\mathrm{Co}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{3}\right]^{3-}$ is a
A. Ligand
B. Optical
C. Geometrical
D. Ionisation

## Answer: B

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18. Which one of the following octahedral complexes will not show geometrical isomerism? (A and $B$ are monodentate ligands)
A. a. $\left[M A_{3} B_{3}\right]$
B. b. $\left[M A_{4} B_{2}\right]$
C. c. $\left[M A_{5} B\right]$
D. d. $\left[M A_{2} B_{4}\right]$

## Answer: C

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19. Facial-meridional isomers is associated with which one of the following complex ( $M=$ central metal).
A. $\left[M(A A)_{2}\right]$
B. $\left[M A_{3} B_{3}\right]$
C. [MABCD]
D. $\left[M(A A)_{3}\right]$

## Answer: B

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20. The total number of possibel coordination isomer for the given compounds $\left[\mathrm{Pt}\left(\mathrm{NH}_{3}\right)(4) \mathrm{Br}_{2}\right]\left[\mathrm{PtBr}_{4}\right]$ is .
A. 2
B. 4
C. 5
D. 3

## Answer: B

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21. The following complexs are given?
trans $-\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} 1_{2}\right]^{\oplus}$
cis - $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2}(\mathrm{en})_{2}\right]^{3+}$
trans- $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{2}(e n)_{2}\right]^{3+}$
$[\text { Ni1_(4) }]^{\wedge}(2-)[\text { Tif_(6) }]^{\wedge}(2-)[\text { CoF_(6) }]^{\wedge}(3-)^{\prime}$
Choose the correct code .
A. 4,5 are coloured 6 is colourless
B. 2 is optically active 1,3 are optically inactive
C. 1, 2 are optically active 3 optically inactive .
D. 4 is coloured, 5,6 are colourless .

## Answer: B

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22. The following represents a pair of enantiomers:
A. a.trans $-\left[\mathrm{CrCl}_{2}(e n)_{2}\right]{ }^{\oplus}$
B. b.cis $-\left[\mathrm{CrCl}_{2}(e n)_{2}\right]^{\oplus}$
C. c.trans $-\left[\mathrm{CrCl}_{2}\left(\mathrm{NH}_{3}\right)_{4}\right] \oplus$
D. d.cis - $\left[\mathrm{CrCl}_{2}\left(\mathrm{NH}_{3}\right)_{4}\right]^{\oplus}$

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23. The compounds $\left[\mathrm{PtBr}_{2}\left(\mathrm{NH}_{3}\right)_{2}\right]$ can form .
A. Geometrical isomers
B. Coordination isomers
C. Optical isomers
D. Linkage isomers

## Answer: A

## Watch Video Solution

24. The compound $\left[\mathrm{CrCl}_{2}\left(\mathrm{NH}_{3}\right)_{2}\right.$ (en) $]$ can form .
A. Geometrical isomers
B. Coordination isomers
C. Optical isomers
D. Linkage isomers

## Answer: C

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25. One mole of complex compound $\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{CI}_{3}$ gives 3 moles of ions on dissolution in water One mole of the same complex reacts with two moles of AgNO 3 to yield two moles of AgCl The complex is :
A. a. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{Cl}\right] \mathrm{Cl}_{2}$. $\mathrm{NH}_{3}$
B. b. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{Cl}_{2}\right] \mathrm{Cl} . \mathrm{NH}_{3}$
c. c. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Cl}\right] \mathrm{Cl}_{2}$
D. d. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right) \mathrm{Cl}_{3} .2 \mathrm{NH}_{3}\right.$

## Answer: C

## Watch Video Solution

26. Which of the following will show optical isomerism? .
A. $\left[\mathrm{ZnCl}_{4}\right]^{2-}$
B. $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$
c. $\left[\operatorname{Cr}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{3}\right]^{3-}$
D. $\left[\mathrm{Co}(\mathrm{CN})_{6}\right]^{3-}$

## Answer: C

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27. In which of the following pairs both the complex's show optical isomerism?
A. a)cis - $\left[\mathrm{Cr}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{2} \mathrm{CI}_{2}\right]^{3-}$, cis - $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right]$
B. b) $\left[\mathrm{Co}(\mathrm{en})_{3}\right]_{C I_{3}}$, cis $-\left[\mathrm{Co}(\mathrm{en})_{2} \mathrm{CI}_{2}\right]_{C I}$
C. c) $\left[\mathrm{Co}\left(\mathrm{NO}_{3}\right)_{3}\left(\mathrm{NH}_{3}\right)_{3}\right]$, cis $-\left[\mathrm{Pt}(e n)_{2} \mathrm{CI}_{2}\right]$
D. d) $[\mathrm{PtCI}(e n) \mathrm{CI}],\left[\mathrm{NiCI}_{2} \mathrm{Br}_{2}\right]^{2-}$

## Answer: B

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28. Which of the following shows maximum number of isomers ?
A. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{Cl}_{2}\right]$
B. $\left[\mathrm{Ni}(e n)\left(\mathrm{NH}_{3}\right)_{4}\right]^{\oplus}$
C. $\left[\mathrm{Ni}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)(e n)_{2}\right]$
D. $\left[\mathrm{Cr}(\mathrm{SCN})_{2}\left(\mathrm{NH}_{3}\right)_{4}\right]^{\oplus}$

## Answer: D

29. The possible number of the optical isomers in $\left[\mathrm{Cr}(e n)_{2} \mathrm{CI}_{2}\right]^{\oplus}$ is .
A. 6
B. 3
C. 4
D. 2

## Answer: B

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30. Which of the following molecules(s)is/are not showing optical isomerism?.
A. $\left[\mathrm{Co}(\mathrm{en})_{3}\right]_{B r_{3}}$
B. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{Br}_{3}\right]$
C. $\left[\mathrm{Co}(\text { en })_{2} \mathrm{Br}_{2}\right] \mathrm{Br}$
D. $\left[\mathrm{Co}(\mathrm{en})\left(\mathrm{NH}_{3}\right)_{2} \mathrm{Br}_{2}\right] \mathrm{Br}$

## Answer: B

## Watch Video Solution

31. Which of the following will give a pair of enantiomorphs?
A. a) $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]\left[\mathrm{Co}(\mathrm{CN})_{6}\right]$
B. b) $\left[\mathrm{Co}(\mathrm{en})_{2} \mathrm{CI}_{2}\right] C I$
C. c) $\left[\operatorname{Pt}\left(\mathrm{NH}_{3}\right)_{4}\right]\left[\mathrm{PtCI}_{6}\right]$
D. d) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right] \mathrm{NO}_{2}$

## Answer: B

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32. Both $\mathrm{Cr}^{3+}$ and $\mathrm{Pt}^{4+}$ have a coordination number of 6 Which of the following pairs of complexes will show approximately the same electrical conductance for their 0.1 M aqueous solutions ?
A. a) $\mathrm{CrCI}_{3} .4 \mathrm{NH}_{3}$ and $\mathrm{PtCI}_{4} .4 \mathrm{NH}_{3}$
B. b) $\mathrm{CrCI}_{3} \cdot 3 \mathrm{NH}_{3}$ and $\mathrm{PtCI}_{4} \cdot 5 \mathrm{NH}_{3}$
C. c) $\mathrm{CrCI}_{3} \cdot 6 \mathrm{NH}_{3}$ and $\mathrm{PtCI}_{4} \cdot 5 \mathrm{NH}_{3}$
D. d) $\mathrm{CrCI}_{3} .5 \mathrm{NH}_{3}$ and $\mathrm{PtCI}_{4} .5 \mathrm{NH}_{3}$

## Answer: C

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33. Select the correct statement for $\left[M(A B) b_{2} c d\right]$.
A. a.All geometrical isomers are optically active .
B. b.lt has four trans isomer with respect to $b$
C. c.lt has seven geometrical isomers .
D. d.It has three cis and two trans isomers with respect to $b$.

## Answer: C

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## Exercises Single Correct (Hybridisation , Magnetic And Optical Properties )

1. The d electron configurations of
$\mathrm{Cr}^{2+}, \mathrm{Mn}^{2+}, \mathrm{Fe}^{2+}$ and $\mathrm{Ni}^{2+}$ are $3 d^{4}, 3 d^{5}, 3 d^{6}$ and $3 d^{8}$ respectively. Which one of the following aqua complexes will exhibit the minimum paramagnetic behaviour? (At. no. of $\mathrm{Cr}=24, \mathrm{Mn}=25, \mathrm{Fe}=26, \mathrm{Ni}=28$ )
A. $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$
B. $\left.\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)\right)_{6}\right]^{3+}$
C. $\left[\mathrm{Mn}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$
D. $\left[\mathrm{Ni}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$

## D Watch Video Solution

2. Which of the following is paramagnetic ?
A. $\left[\mathrm{Fe}(\mathrm{CO})_{5}\right]$
B. $\left[\operatorname{Cr}(\mathrm{CO})_{6}\right]$
C. $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{4-}$
D. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$

## Answer: D

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3. The pair which both the species have the same magnetic moment (spin only) is :
A. a. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+},\left[\mathrm{CoCl}_{4}\right]^{2-}$
B. b. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)\right]^{2+},\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$
C. c. $\left[\mathrm{Mn}\left(\mathrm{H}_{2} \mathrm{O}\right)\right]^{2+},\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$
D. d. $\left[\mathrm{CoCl}_{4}\right]^{2-},\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$

## Answer: B

## D Watch Video Solution

4. Select the correct order of magnetic moment (inBM) from the folliwng options
(I) $\left[\mathrm{MnCI}_{4}\right]^{2-}$ (II) $\left[\mathrm{CoCI}_{4}\right]^{2-}$
(III) $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{4-}$.
A. $I>$ II $>$ III
B. III $>$ II $>$ I
C. III $>I>I I$
D. $I>I I I>I I$

## Answer: A

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5. Which of the pair of complex compounds are tettrahedral as well as diamagnetic?.
A. a. $\left[\mathrm{CoCl}_{4}\right]^{\Theta}$ and $\left[\mathrm{Co}(\mathrm{CO})_{4}\right]^{\Theta}$
B. b. $\left[\mathrm{Ag}(\mathrm{SCN})_{4}\right]^{2-}$ and $\left[\mathrm{NiCl}_{4}\right]^{2-}$
C. c. $\left[\mathrm{Co}(\mathrm{CO})_{4}\right]^{\Theta}$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{4-}$
D. d. $\left[\mathrm{PdCl}_{4}\right]^{2-}$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$

## Answer: C

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6. Which of the following has a square planar geometry? .
A. $\left[\mathrm{PtCl}_{4}\right]^{2-}$
B. $\left[\mathrm{CoCl}_{4}\right]^{2-}$
c. $\left[\mathrm{FeCl}_{4}\right]^{2-}$
D. $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$

## Answer: A

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7. Among $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right],\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-},\left[\mathrm{NiCl}_{2}\right]^{2-}$ species, the hybridisation
${ }^{*}$ states of the Ni atom are, respectively (At. No. of $\mathrm{Ni}=28$ )
A. $s p^{3}, d s^{2} p, d s p^{2}$
B. $s p^{3}, d s p^{2}, s p^{3}$
C. $d s p^{2}, s p^{3}, s p^{3}$
D. $s p^{3}, s p^{3}, d s p^{2}$

## Answer: B

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8. Arrange the following in order of decreasing number of unpaired electrons:
i. $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}_{6}\right)\right]^{2+}$
ii. $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{3-}$
iii. $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{4-}$
iv. $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$
A. IV, I, II, III
B. I, II, III, IV
C. III, II, I, IV
D. II, III, I, IV

## D Watch Video Solution

9. A substance which is not paramagnetic is .
A. $\mathrm{Cr}\left(\mathrm{CIO}_{4}\right)_{3}$
B. $\mathrm{KMnO}_{4}$
C. $\mathrm{TiCI}_{3}$
D. $V O B r_{2}$

## Answer: B

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10. An aqueous solution of titanium bromide shows zero magnetic moment. Assuming the complex as octahedral in aqueous solution the formula of the complex is .
A. $\left[\mathrm{TiBr}_{6}\right]^{3-}$
B. $\left[\mathrm{Ti}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6} \mathrm{Br}_{4}\right.$
C. $\left[\mathrm{TiBr}_{6}\right]^{2-}$
D. $\left.\mathrm{Ti}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4} \mathrm{Br}_{2}\right]$

## Answer: B

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11. Geometry, hybridisation and magnetic moment of the ions $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-},\left[\mathrm{MnBr}_{4}\right]^{2-}$ and $\left[\mathrm{FeF}_{6}\right]^{3-}$ respectively are .
A. Tetrahedral square planar,octahedral $d s p^{2}, s p^{3}, s p^{3}: 0,5.9,4.9$.
B. Tetrahedral square planar,octahedral $s p^{3}, d s p^{2}, s p^{3} d^{2}: 5.9,0,4,9$.
C. Square planar,tetrahedral,octahedral: $d s p^{2}, s p^{3}, d^{2} s p^{3}: 5.9,4.9,0$.
D. Tetrahedral square planar,octahedral $d s p^{2}, s p^{3}, s p^{3} d^{2}: 0,5,4.9$.
12. The correct order of magnetic moment (spin values in is .
(Atomic number $\mathrm{Mn}=25, \mathrm{Fe}=26, \mathrm{Co}=27$ )
(I) $\left[\mathrm{MnBr}_{4}\right]^{2-}(\mathrm{II})\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{4-}$ (III) $\left[\mathrm{CoBr}_{4}\right]^{2-}$.
A. II $>$ III $>I$
B. I $>$ II $>$ III
C. $I I>I>I I I$
D. $I>I I I>I I$

## Answer: D

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13. A square planar complex is formed by hybridisation of which atomic oritals?
A. $s, p_{x}, p_{y}, d_{y z}$
B. $s, p_{x}, p_{y}, d_{x 2-y 2}$
C. $s, p_{y}, p_{z}, d_{x y}$
D. $s, p_{x}, p_{y}, d_{x 2}$

## Answer: B

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14. The colour of a complex compound is due to .
A. Promotion of 3d-electrons of the central atom//ion to 4 p -orbitals.
B. Promation of 3d-electrons of the central atom//ion to 4 s -orbitals
C. Promation of 3d-electrons of the central atom//ion within d -orbitals
D. Promation of 4 s -electrons of the central atom//ion to 4 p -orbitals

## Answer: C

15. If a transition-metla compound absorbs violet-indigo radiation in the visible region Its colour would be .
A. Green
B. Yellow
C. Orange
D. Blue

## Answer: B

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16. Transition metal compounds are usually coloured This is due to the electronic transition .
A. From d-orbital to s-orbital
B. From p-orbital to s-orbital
C. From d-orbital to s-orbital
D. Within the d-orbital

## Answer: D

## - Watch Video Solution

17. Which of the following compounds is not coloured ?
A. $\mathrm{Na}_{2}\left[\mathrm{CuCl}_{4}\right]$
B. $\mathrm{Na}_{2}\left[\mathrm{CdCl}_{4}\right]$
C. $K_{4}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$
D. $K_{3}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$

## Answer: B

## D Watch Video Solution

18. The colour of $\mathrm{Cu}^{\oplus}$ compounds is .
A. White
B. Blue
C. Orange
D. Yellow

## Answer: A

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## Exercises Single Correct (Crystal Field Theory (Cft))

1. Which of the following complex has higher $\Delta_{0}$ VALUE?
A. $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$
B. $\left[\mathrm{FeCl}_{6}\right]^{3-}$
C. $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$
D. All have equal

## Answer: C

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2. Relative to the average enerage in the spherical crystal field the $t_{2 g}$ orbitals in tetrahedral field is .
A. Reised $(2 / 5) \Delta_{t}$
B. Lowered by $(2 / 5) \Delta_{t}$
C. Reised $(3 / 5) \Delta_{t}$
D. Lowered by $(1 / 5) \Delta_{t}$

## Answer: A

3. The crystal field splitting energy for octahedral $\left(\Delta_{0}\right)$ and tetrahedral $\left(\Delta_{t}\right)$ complexes is related as.
A. $\Delta_{t}=\frac{4}{9} \Delta_{0}$
B. $\Delta_{t}=\frac{1}{2} \Delta_{0}$
C. $\Delta_{0}=-2 \Delta_{t}$
D. $\Delta_{0}=-\frac{4}{9} \Delta_{t}$

## Answer: A

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4. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right] \mathrm{Cl}_{3}$ (at no. of $\mathrm{Cr}=24$ ) has a magnetic moment of 3.83 B.M . The correct distribution of 3d electrons in the chromium present in the complex is
A. $3 d_{x y}^{1}, 3 d_{y z}^{1}, 3 d_{z x}^{1}$
B. $3 d_{x y}^{1}, 3 d_{y z}^{1}, 3 d_{z 2}^{1}$
C. $3 d^{1}\left(x^{2}-y^{2}\right)^{3 d^{2}}{ }^{1}, 3 d_{x z}^{1}$
D. $3 d_{x y}^{1}, 3 d^{1}\left(x^{2}-y^{2}\right), 3 d^{1} x z$

## Answer: A

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5. In which of the following cordination entities, the magnitude of $\Delta_{0}$ [CFSE in octahedral field] will be maximum ?
A. $\left[\mathrm{Co}(\mathrm{CN})_{6}\right]^{3-}$
B. $\left[\mathrm{CoF}_{6}\right]^{3-}$
C. $\left[\mathrm{Co}\left(\mathrm{NO}_{2}\right)_{6}\right]^{3-}$
D. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$

## Answer: A

6. In which of the following configuration will there be the possibillity of both para and diamagnetism depending on the nature of the ligands ?
A. $d^{3}$
B. $d^{7}$
C. $d^{6}$
D. $d^{5}$

## Answer: C

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7. For $\mathrm{Mn}^{3+}$ ion the electron pairing energy $P$ is about $28,000 \mathrm{~cm}^{1-}, \Delta_{0}$ values for the complexes $\left[\mathrm{Mn}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$ and $\left[\mathrm{Mn}(\mathrm{CN})_{6}\right]^{3-}$ are $15,800 \mathrm{~cm}^{-1}$ and $38,500 \mathrm{~cm}^{-1}$ respectively which of the following complex is high spin .
A. Both are high spin
B. $\left[\mathrm{Mn}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$
C. $\left[\mathrm{Mn}(\mathrm{CN})_{6}\right]^{3-}$
D. Noen of these

## Answer: B

## - Watch Video Solution

8. Which of the following ligands are correctly represented in an spectrochemical series?.
A. a.SCN ${ }^{\Theta}, F^{\Theta}, C N^{\Theta}$
B. b. $S C N^{\Theta}, C N^{\Theta}, F^{\Theta}$
C. c. $F^{\Theta}, S C N^{\Theta}, C N^{\Theta}$
D. d. $F^{\Theta}, C N^{\Theta}, S C N^{\Theta}$

## Answer: A

9. The increasing of the crystal field splitting power of some common ligands is?.
A. $\mathrm{NH}_{3}<\mathrm{NO}_{2}^{\Theta}<\mathrm{CN}^{\Theta}<\mathrm{H}_{2} \mathrm{O}$
B. $\mathrm{H}_{2} \mathrm{O}<\mathrm{NO}_{2}^{\Theta}<\mathrm{CN}^{\Theta}<\mathrm{NH}_{3}$
C. $\mathrm{H}_{2} \mathrm{O}<\mathrm{NH}_{3}<\mathrm{NO}_{2}^{\Theta}<\mathrm{CN}^{\Theta}$
D. $\mathrm{H}_{2} \mathrm{O}<\mathrm{NH}_{3}<\mathrm{CN}^{\Theta}<\mathrm{NO}_{2}^{\Theta}$

## Answer: C

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10. The value of the spin only magnetic moment for one of the following configuration is 2.84 . B.M. The correct one is
A. $d^{4}$ (in strong field ligand)
B. $d^{2}$ (in strong field ligand)
C. $d^{3}$ (in weak as well as in strong field ligand)
D. $d^{5}$ (in strong field ligand)

## Answer: B

## - Watch Video Solution

11. The complex which has no d-electron in the central metal atom is .
A. $\left[\mathrm{MnO}_{4}\right]^{\Theta}$
B. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$
C. $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{3-}$
D. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$

## Answer: A

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12. Which of the following statement is correct for the complex $\mathrm{Ca}_{2}\left[\mathrm{Fe}(\mathrm{CN})_{5} \mathrm{O}_{2}\right]$ having $t_{2 g}^{6}, e_{g}^{0}$ electronic configuration ? .
A. $d^{2} s p^{3}$ hybridised and diamagnetic
B. $s p^{3} d^{2}$ hybridised and paramagnetic
C. $s p^{3} d^{2}$ hybridised and diamagnetic
D. $d^{2} s p^{3}$ hybridised and paramagnetic

## Answer: D

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13. Which of the folliwing complex is inner orbital as well as low spin complex? .
A. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$
B. $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{3-}$
c. $\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]^{3-}$
D. $\left[\mathrm{Mn}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$

## Answer: B

## - Watch Video Solution

14. The magnetic moment of a complex (A) of Co was found to be 4.89BM and the EANas36 co alos forms complex (B) with magnetic moment 3.47BM and EAN as37 and complex (C) with EAN as 36but diamagnetic Which of the following statements is true regarding the above observation?
A. The oxidation states of Co in (A),(B) and (C) are $+3,+2$ and +3 respectively .
B. Complexes $(A)$ and $(B)$ have $s p^{3} d^{2}$ hybridisation state while $(C)$ has $d s p^{3}$ hybrisation state .
C. The spin multiplicities of Co in (A), (B) and (C) are 3,2 and 1,respectively .
D. The oxidation states of $C o$ in $(A),(B)$ and $(C)$ are $+6,+8$ and +1 respectively .

## Answer: A

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15. Spin only magnetic moments of a $d^{8}$ ion in octahedral square planar and tetrahedral complexes, respectively are .
A. $2.8 B M, 0$ and $2.8 B M$
B. 0,0 and $B M$
C. 2.8, 2.8 and $B M$
D. None of these

## Answer: A

 Miscellaneous)1. Which of the following is incorrect about Wilkinson s catalyst ? .
A. a)It is a diamagnetic complex
B. b)It is a non-ionic complex
C. c)It is a tetrahedral complex
D. d)It is very effective for selective hydrogenation of organic molecule at room temperature and pressure.

## Answer: C

## - View Text Solution

2. Which bond properties are consistent with one another?

Bondorder Bondlength Vibrationalequency
A.
higher shorter higher

Bondorder
Bondlength
B. lower
C. higher
Bondorder Bondlength
D. lower

Bondorder Bondlength Vibrationalequency
shorter lower
lower
Vibrationalequency
higher

## Answer: A

## - Watch Video Solution

3. Compare C-C bond length (x) of $C_{2} H_{4}$ in Zeise 's salt and $C-C$ bond length (y) of $\mathrm{C}_{2}(\mathrm{CN})_{4}$ in $K\left[\mathrm{PtCI}_{3} \mathrm{C}_{2}(\mathrm{CN})_{4}\right]$.
A. $x>y$
B. $y>x$
C. $x=y$
D. None of these

## Answer: B

4. Which of the following organometallic compounds is $\sigma$ and $\pi$-bonded?
A. $\left[\mathrm{Fe}\left(\eta^{5}-\mathrm{C}_{5} \mathrm{H}_{5}\right)_{2}\right]$
B. $K\left[\operatorname{PtCI}_{3}\left(\eta^{2}-\mathrm{C}_{2} \mathrm{H}_{4}\right)\right]$
C. $\left[\mathrm{Co}(\mathrm{CO})_{5} \mathrm{NH}_{3}\right]^{2+}$
D. $\left[\mathrm{Fe}\left(\mathrm{CN}_{3}\right)_{3}\right]$

## Answer: C

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5. Which of the following statement(s) is//are true or false?
$S_{1}$ Complexes having $d^{0}$ or $d^{10}$ configuration of metal ions are always diamagnetic
$S_{2}$ In organometallic compounds, carbon is bonded to metals directly $S_{3} \ln \mathrm{Fe}(\mathrm{CO})_{5}$ the $\mathrm{Fe}-\mathrm{C}$ bond possesses both $\sigma$ and $\pi$ characteristics $S_{4}$ Extra stability of metal carbonyls is explained by synergic bonding .
A. TTTT
B. FTFT
C. TTFF
D. FTTT

## Answer: A

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6. Which of the following molecules can act as an oxidising agent as well as a reducing agent?
A. $\mathrm{Mn}(\mathrm{CO})_{5}$
B. $\mathrm{Ti}(\mathrm{CO})_{6}$
C. $\mathrm{Mn}(\mathrm{CO})_{6}$
D. None of these
7. Which of the following statements is correct for the $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{5} \mathrm{NO}\right] \mathrm{SO}_{4}$ complex ? .
A. The EAN value of Fe in this complex depends on the charge of $N O$ ligand.
B. The EAN value of Fe in this complex depends on the charge of $N O$ ligand.
C. The hybridisation of the central atom is $d^{2} s p^{3}$.
D. It is paramagnetic with $\mu=1.73 \mathrm{BM}$.

## Answer: B

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8. Which of the following may be considered to be an organometallic compound?
(a)Ferrocene
(b)cis platin
(c)Zeise's salt
(c)Grignard reagent
A. Ferrocene
B. Cis-platin
C. Zeise's salt
D. Grignard reagent

## Answer: B

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9. Among the following which is not the $\pi$-bonded organometallic
A. $\left(\mathrm{CH}_{3}\right)_{4} \mathrm{~Pb}$
B. $\left[C r\left(\eta^{6}-C_{6} H_{6}\right)_{2}\right]$
C. $\left[F e\left(\eta^{5}-C_{5} H_{5}\right)_{2}\right]$
D. $K\left[\operatorname{PtCI}_{3}\left(\eta^{2}-C_{2} H_{4}\right)\right]$

## Answer: A

## D Watch Video Solution

10. Magnesium is an important component of which biomolecule occuring extensively in living world?
A. Haeomoglobin
B. Chlorophy11
C. Florigen
D. ATP
11. State True/ False.

Among the properties reducing oxidising, complexing the set of properties shown by $C N^{\Theta}$ ion towards metal species is as Oxidising Agent.

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12. Among the properties $(A)$ reducing $(B)$ oxidising $(C)$ complexing the set of properties shown by $C N^{\Theta}$ ion towards metal species is .
A. B, C
B. $A, B, C$
C. $C, A$
D. $A, B$

## Answer: C

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13. Ferrocene is described by the formula
A. $\left[\mathrm{Fe}\left(\eta^{2}-\mathrm{C}_{6} \mathrm{H}_{5}\right)_{2}\right]$
B. $\left[\mathrm{Fe}\left(\eta^{5}-\mathrm{C}_{5} \mathrm{H}_{5}\right)_{2}\right]$
C. $\left[F e\left(\eta^{6}-C_{6} H_{5}\right)_{2}\right]$
D. $\left[\mathrm{Fe}\left(\eta^{3}-\mathrm{C}_{3} \mathrm{H}_{3}\right)_{2}\right]$

## Answer: B

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14. Dimethylglyoxime is coordinated to $\mathrm{Ni}^{2+}$ through .
A. Two oxgen atoms
B. Two nitrogen atoms
C. Two oxygen and one nitrogen atoms
D. Two oxygen and one nitrogen atoms

## Answer: B

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15. in isolated condition $C-C$ bond length of $C_{2} H_{4}$ is $x$ than the bond length ofn $C-C$ bond of $C_{2} H_{4}$ in Zeise 's salt is .
A. Greater thanx
B. Less than $x$
C. Equal to $x$
D. None of these

## Answer: B

16. When $\mathrm{K}_{4}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$ is treated with $\mathrm{FeCI}_{3}$ a blue colour is obtained It is due to the formation of .
A. $F e^{I I}\left[F e^{I I I}(C N)_{6}\right]^{\Theta}$
B. $F e^{I I I}\left[F e^{I I}(C N)_{6}\right]^{\Theta}$
C. Both (a) and (b)
D. None of these

## Answer: C

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17. Which of the following statement is correct among the species $C N^{\Theta}, \mathrm{CO}$ and $\mathrm{NO}^{\oplus}$.
A. bond order three ans isoelectronic
B. bond order three and weak field ligands
C. isoelectronic and weak field ligands
D. bond order two and pi acceptors.

## Answer: A

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18. Consider the follwing complex:
$\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{CO}_{3}\right] \mathrm{Br}$
The coordiantion number, oxidation number, number of d-electrons and number of unpaired d-electrons of the metal are respectively:
A. $6,3,6,0$
B. 7, 1, 6, 4
C. 7, 2, 7, 1
D. $6,2,7,3$

## Answer: A

19. The bond length of $C-O$ bond in carbon monoxide is $1.128 A$ The $C-O$ bond in $\left[f e(C O)_{5}\right]$ is .
A. 1.115 A
B. $1.128 A$
C. $1.178 A$
D. 1.150 A

## Answer: D

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20. The most stable ion is .
A. $\left[\mathrm{Fe}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{3}\right]^{3-}$
B. $\left[\mathrm{Fe}(\mathrm{Cl})_{6}\right]^{3-}$
C. $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$
D. $\left[\mathrm{Fe}(\mathrm{SCN})_{6}\right]^{3-}$

## Answer: A

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21. The number of sigma and $\pi$-bonds in $\mathrm{Fe}_{2}(\mathrm{CO})_{9}{ }^{`}$ respectively are .
A. $22 \sigma$ and $15 \pi$
B. $22 \sigma$ and $16 \pi$
C. $23 \sigma$ and $15 \pi$
D. $15 \sigma$ and $8 \pi$

## Answer: A

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22. $\mathrm{Ag}^{\oplus}$ forms complexes some of these are $\left[\mathrm{Ag}\left(\mathrm{NH}_{3}\right)_{2}\right]^{\oplus}, 2\left[\mathrm{Ag}(\mathrm{CN})_{2}\right]^{\Theta},\left[\mathrm{Ag}\left(\mathrm{S}_{2} \mathrm{O}_{3}\right)_{2}\right]^{3-}$

Which of the following statements is true? .
A. In these complexes, $A g^{\oplus}$ is a Lewis bese .
B. The hybrisation $\mathrm{Ag}^{\oplus}$ is $s p^{2}$.
C. The $\mathrm{Ag}^{\oplus}$ complexes are good reducing agents.
D. These complexes are all linear .

## Answer: D

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23. Hardness of water is estimated by simple complex formation titration Complex formed by cation in hard water during estimation of hardness is
A. $\mathrm{Na}_{2}\left[\mathrm{Ca}\left(\mathrm{PO}_{3}\right)_{6}\right]$
B. $N a_{2}[M g(E D T A)]$
C. $\left[\mathrm{Ca}\left(\mathrm{So}_{4}\right)_{2}\right]^{2-}$
D. $\operatorname{Na}[P b(E D T A)]$

## Answer: B

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24. The ligand called $\pi$ acid is
A. CO
B. $\mathrm{C}_{2} \mathrm{O}_{2}^{2-}$
C. $\mathrm{NH}_{3}$
D. ethylene

Answer: A
25. Which of the following complexes is used to be as an anticancer agent?
A. $\mathrm{mer}-\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{CI}_{3}\right]$
B. cis - $\left[\mathrm{PtCI}_{2}\left(\mathrm{NH}_{3}-(2)\right]\right.$
C. $\mathrm{Na}_{2}\left[\mathrm{CoCI}_{4}\right]$
D. cis - $\mathrm{K}_{2}\left[\mathrm{Pt}^{\left(C I_{2} \mathrm{Br}_{2}\right]}\right.$

## Answer: B

## - Watch Video Solution

26. Which is uses in cancer chemotherapy? .
A. cis-platin
B. Zeisse's salt
C. Both(a) and(b)
D. Noe of these

## Answer: A

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27. Zeise' $s$ salt is
A. $\mathrm{Cr}\left(\eta^{6}-\mathrm{C}_{6} \mathrm{H}_{6}\right)_{2}$
B. $\mathrm{Fe}\left(\eta^{5}-\mathrm{C}_{5} \mathrm{H}_{5}\right)_{2}$
C. $K\left[P t\left(\eta^{2}-\mathrm{C}_{2} \mathrm{H}_{4}\right) \mathrm{Cl}_{3}\right]$
D. $K\left[P t\left(\eta^{2}-\mathrm{C}_{2} \mathrm{H}_{4}\right)_{2} \mathrm{Cl}_{2}\right]$

## Answer: C

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28. What is the colour of methyl orange in slaked lime.

## Exercises Assertion Reasoning

1. A: All square planar complexes can exhibit geometrical isomerism.

R: In square planar complexes metal assumes $s p^{3}$ hybridisation.
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of
(A).
B. If both (A) and (R) are correct and (R) is not the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both (A) and ( $R$ ) are incorrect .
2. Assertion Metal carbonyls can be called organometallics

Reason Metal carbonyls do contain metal carbon bond .
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both (A) and (R) are incorrect .

## Answer: D

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3. Assertion A sulphate ion is a biden tate ligand and can also act as monodentate in cartain complexes

Reason Many a times multidentate ligands do have flexidentate character
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both (A) and (R) are correct and (R) is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: A

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4. Assertion: Optical isomerism is not shown by square planar complexes .

Reason :Square planar complexes do not possess chiral structures.
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both (A) and (R) are correct and (R) is not the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both (A) and (R) are incorrect .

## Answer: A

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5. Assertion In aqueous solution Mohr's salt gives $\mathrm{NH}_{4}^{\oplus} \mathrm{Fe}^{2+}$ and $\mathrm{SO}_{4}^{2-}$ ions

Reason Mohr' s salt is a double salt .
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but ( $R$ ) is incorrect .
D. Both (A) and ( $R$ ) are incorrect .

## Answer: A

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6. Assertion Coordination compounds are generally formed by transition metals

Reason Transition metals generally have partly filled d-orbitals of the nth shell .
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both (A) and (R) are correct and (R) is the correct explanation of
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both (A) and ( $R$ ) are incorrect .

## Answer: C

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7. Assertion Chelates are relatively more stable than non-cheltated complexes

Reason Complexes containing ligands which can be easily replaced by other ligands are called labile complexes .
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: B

## - Watch Video Solution

8. Assertion The complex $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{CI}_{3}\right]$ gives no precipitate with $\mathrm{AgNO}_{3}$ solution

Reason The given complex is non-ionisable .
A. If both (A) and (R) are correct and (R) is the correct explanation of
(A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: A

9. Ethylenediaminetraac etate ion froms an octo hedral complex with be metal ion

Reason It has six donor atoms which coordinate simultaneously to the metal ion.
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both (A) and (R) are incorrect .

## Answer: A

## - Watch Video Solution

10. Assertion The $\left[\mathrm{Ni}(e n)_{3}\right] \mathrm{CI}_{2}$ (en = ethylenediamine has lower stability than $\left[\mathrm{Ni}\left(\mathrm{NH}_{3}\right)_{6}\right] \mathrm{CI}_{2}$
Reason $\operatorname{In}\left[\mathrm{Ni}(e n)_{3}\right] \mathrm{CI}_{2}$ the geometry of Ni is trigonal bipyramidal .
A. If both (A) and (R) are correct and (R) is the correct explanation of
(A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both (A) and (R) are incorrect .

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11. Assertion : $\mathrm{NF}_{3}$ is a weaker ligand than $N\left(\mathrm{Ch}_{3}\right)_{3}$

Reason : $\mathrm{NF}_{3}$ ionizes to give $\mathrm{F}^{-}$ions in aqueous solution.
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: C

## - Watch Video Solution

12. Assertion The total number of isomers shown by $\left[\mathrm{Co}(e n)_{2} \mathrm{CI}_{2}\right]^{\oplus}$ complex ion is three
$\left[\mathrm{Co}(e n)_{2} \mathrm{CI}_{2}\right]^{2+}$ complex ion has an octahedral geometry .
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but ( $R$ ) is incorrect .
D. Both (A) and ( $R$ ) are incorrect .

## Answer: B

## - Watch Video Solution

13. Assertion The ligands nitro and nitrito are called ambidenatate Reason These ligands give likage isomers .
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: A

## - Watch Video Solution

14. Assertion Number of unpaired electrons present in $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)(2)\right]^{\oplus}$ complex is zero

Reason The complex is linear with sp-hybrisation .
A. If both (A) and (R) are correct and (R) is the correct explanation of
(A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of
(A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: B

15. Assertion Glycinate ion is an example of monodentate ligand Reason It contains $N$ as the only donor atom .
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

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16. Assertion The number of unpaired electrons in $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$ is zero

Reason In this compounds 4 s -electrons of Ni atom enter the inner d -
orbitals to facilitate the $s p^{3}$ hybridisation in Ni atom .
A. If both (A) and (R) are correct and (R) is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: A

## - Watch Video Solution

17. Assertion $\mathrm{Ni}(\mathrm{CO})_{4}$ is tetrahedral in shape

Reason $N i$ atom is in zero oxidation state and undergoes $s p^{3}$ hybridisation in $\mathrm{Ni}(\mathrm{CO})_{4}$.
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: A

## - Watch Video Solution

18. Assertion $\left[M(A A)_{3}\right]^{n \pm}$ is optically inactive

Reason Plane of symmetry and center of symmetry are not present .
A. If both (A) and (R) are correct and (R) is the correct explanation of
(A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both (A) and ( $R$ ) are incorrect .

## Answer: D

## - Watch Video Solution

19. Assertion The $d_{C-O}$ in bridging carbonyl geroup is longer than that of terminal carbonyl group

Reason With increase in extent of synergic bonding the $C-O$ bond length increases .
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both (A) and ( $R$ ) are incorrect .

## Answer: A

## - Watch Video Solution

20. Assertion A solution of $\left[\mathrm{Ni}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$ is green but a solution of $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2+}$ is colourless
Reason $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2+}$ is square planar complex.
A. If both (A) and (R) are correct and (R) is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## D Watch Video Solution

$$
\begin{aligned}
& \text { 21. } \Delta_{0} \text { increases in the order of } \\
& {\left[\mathrm{CrCI}_{6}\right]^{3-}<\left[\mathrm{Cr}(\mathrm{CN})_{6}\right]^{3-}<\left[\mathrm{Cr}\left(\mathrm{C}_{2} \mathrm{O}_{4}\right)_{3}\right]^{3-}}
\end{aligned}
$$

reason The stronger the ligand field the higher will be $\Delta_{0}$ value .
A. If both (A) and (R) are correct and (R) is the correct explanation of
(A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: D

22. Assertion Hybridisation of $\left[A u C I_{4}\right]^{\Theta}$ is $s p^{3}$

Reason Hybridisation of Au in above complex compound does not depend upon the nature of ligand.
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of
(A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: D

## - Watch Video Solution

23. Assertion $\mathrm{NO}^{\oplus}$ has a lower pi accepting tendency than the CO

Reason No donates 3 electrons into the vacant orbital of metal cation or
atom.
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but ( $R$ ) is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: D

## - Watch Video Solution

24. Assertion Complexes containing three bidentate ligands do not show optical activity

Reason Octahedral complex $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right]$ CI shows geometrical isomerism .
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and (R) is the correct explanation of (A).
C. If $(A)$ is correct, but $(R)$ is incorrect .
D. Both (A) and (R) are incorrect .

## Answer: D

## - Watch Video Solution

25. AssertionCu ${ }^{\oplus}$ ion is unstable in aqueous solution, whereas $\mathrm{Fe}^{2+}$ ion is stable
$C u^{\oplus}$ disproportionate in aqueous solution .
A. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
B. If both $(A)$ and $(R)$ are correct and $(R)$ is the correct explanation of (A).
C. If $(A)$ is correct, but ( $R$ ) is incorrect .
D. Both $(A)$ and $(R)$ are incorrect .

## Answer: A

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## Exercises Integer (Naming And Terminology)

1. Give the number of ligand(s) in which donor atoms is only $\mathrm{NNH}_{2} \mathrm{CH}_{2} \mathrm{COO}^{\Theta}$, en, dinen, Py, EDTA ,ph .

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2. Give number of non-classical ligands which are negative ligands
$C N^{\Theta}, S_{2} O_{3}^{2-}, C_{3} H_{5}^{\Theta}, C_{5} H_{5}^{\Theta}$.

## - Watch Video Solution

3. Give the number of ligand which are monodentate as well as ambidentate
$\mathrm{C}_{3}^{2-}, \mathrm{CH}_{3} \mathrm{COO}^{\Theta}, X^{\Theta}, \mathrm{H}^{\Theta}, \mathrm{SO}_{4}^{2-}$.

## D Watch Video Solution

4. Give the number of ligands which are monodentate as well as ambidentate

$$
\stackrel{\Theta}{C N}, C_{2} O_{4}^{2-}, S_{2}^{2-}, N O_{2}^{\Theta}, \stackrel{\Theta}{O C N}, S C N^{\Theta}
$$

## D Watch Video Solution

5. Give the number of strong field ligand(s) from the following
$\mathrm{NH}_{3}$, en, $\mathrm{CI}^{\Theta}, \mathrm{CH}_{3} \mathrm{COO}^{\Theta}, \stackrel{\Theta}{\mathrm{CN}}, \mathrm{CO}, \mathrm{NO}_{2}^{\Theta}$.
6. Give the number of weak filed ligand (s) from the following
$\Theta$
$S^{2}, O H, C I^{\Theta}, H_{2} \Theta, N_{3} \Theta .$.

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7. The sum of primary and secondary valencies of chromium in the complex $\mathrm{CrBr}_{3} \cdot 6 \mathrm{NH}_{3}$ is .

## - Watch Video Solution

8. Find the number of ligand (s) which is//are polydentate ligand en, $C_{2} O_{4}^{2-}$ acac, $D M G$ gly,ph .

## - Watch Video Solution

9. Find the number of ligand (s) which is//are polydentate ligand en, dmgdienEDTA`.

## - Watch Video Solution

10. How many corrdinated water molecule(s) is//are present in brown ring complex ? .

## - Watch Video Solution

11. Sodium nitroprusside is used to test $S^{2-}$ ion How many $C N^{\Theta}$ ion acts as ligand in the compound.

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12. Give the number of ligand(s) which is//are non-classical ligand $\Theta$
$S^{\Theta} C N, O C N, S_{2} O_{3}^{2-}, C_{2} O_{4}^{2-}, S^{2-}$.
13. Give the number of ligand(s) which is//are non-classical ligand $\mathrm{CO}, \mathrm{NO}, \mathrm{C}_{2} \mathrm{H}-$ (4), $\mathrm{C}_{3} \mathrm{H}_{5} \Theta, H^{\Theta}$.

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14. Give the number of ligand(s) which is//are non-classical ligand $\mathrm{CO}, \mathrm{NO}, \mathrm{C}_{2} \mathrm{H}-(4), \mathrm{C}_{3} \mathrm{H}_{5} \Theta, H^{\Theta}$.

## - Watch Video Solution

15. Give the number of ligand(s) which is/are non-classical ligand an $\pi$ donor as well as pi acceptor ligand $\mathrm{CO}, \mathrm{PH}_{3}, \mathrm{PF}_{3}, \mathrm{C}_{3} \mathrm{H}_{5}^{\Theta}, \mathrm{C}_{5} \mathrm{H}_{5} \Theta$.

## - Watch Video Solution

16. What are the values of m and n in the anionic species $\left[V(C O)_{m}\right]^{n-}$ if it is flowing Sidwick EAN rule and having octahedral shape? .

## - Watch Video Solution

## Exercises Integer (Isomerism)

1. Give the total number of possible isomers of $\left[\mathrm{ZnBr}_{2} \mathrm{~F}_{2}\right]^{2-}$.

## - Watch Video Solution

2. Give the number of pair enantiomer of $\left[M a_{2} b_{2} c d\right]$.

## - Watch Video Solution

3. Give the total number of isomer of $\left[B e(g l y)_{2}\right]$
4. How many pairs of enantiomers are possible for $[M(A A)(B C) d e]$ ? .

## - Watch Video Solution

5. Find the number of geometrical isomers in $\left[\mathrm{Co}(\mathrm{en})(\mathrm{Pn})\left(\mathrm{NO}_{2}\right)_{2}\right]$
$\left[\mathrm{Co}(\mathrm{en})(\mathrm{Pn})\left(\mathrm{NO}_{2}\right)_{2}\right]$.


## - Watch Video Solution

6. Give an example of a reaction which is combination as well as exothermic.

## - Watch Video Solution

7. Write the sum of geometrical isomers in $\left[\mathrm{Ma}_{2} b_{2} c_{2}\right]$ complex and stereoisomers in $\left[M(A B)_{3}\right]$ complex .

## - Watch Video Solution

8. Give the ration of geometrical isomers in $\left[M(A A)_{2} b_{2}\right]$ and optical isomers of $\left[M(A A)_{3}\right]$.

## - Watch Video Solution

9. Give the number of geometrical isomers in $\left[\mathrm{Pt}(\mathrm{gly})_{2}\right]$.

## - Watch Video Solution

10. Give the total number of possible isomers of
$\left[\mathrm{Co1}_{2}(\mathrm{CN})\left(\mathrm{NH}_{3}\right) \mathrm{en}\right]$.
11. Give the number of possibel isomers of
$\left[\mathrm{CrCl}_{2} e_{2}\right]^{\oplus}$.

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12. Give the total number of possible structural isomers of the compound II
$\left(\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]\left[\begin{array}{c}\mathrm{II} \\ \mathrm{PtCl}_{4}\end{array}\right]$.

## - Watch Video Solution

13. Give the number of total possible ionisation isomers in $\left[P t\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right] \mathrm{Br}_{2}$.

## - Watch Video Solution

14. The number of geometrical isomers for $\left[\mathrm{Pt}\left(\mathrm{NH}_{3}\right)_{2}\right] \mathrm{Cl}_{2}$ is

## - Watch Video Solution

15. Give the ratio of trans- isomers is $\left[M\left(\mathrm{Aab}_{2} \mathrm{c}_{2}\right](\mathrm{A})\right.$ and $\left[\mathrm{Ma}_{4} \mathrm{~b}_{2}\right]_{(B)}$ respectively.

## - Watch Video Solution

## Exercises Integer (Hybridisation , Vbt , Cft And Application)

1. In hexacyanidomanganate(II) ion the Mn atom assumes $d^{2} s p^{3}$ - hybrid sates. Then the number of unpaired electrons in the complex is .

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2. Give the number of unpaired electron(s) in the complex ion $\left[\mathrm{CoCI}_{6}\right]^{3-}$.
3. Predict the number of unpaired electrons in a tetrahedral $d^{6}$ ion and in a square planar $d^{7}$ ion.

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4. Give the number of unpaired electron present in the d-orbitals (whose lobes are present along the axis) for the complex $\left[\mathrm{Co}(\mathrm{SCN})_{4}\right]^{2-}$.

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5. Give the number of $3 d$ electrons occupied in $t_{2 g}$ orbitals of hydrated $\mathrm{Cr}^{3+}$ ion (octahedral).

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6. How many unpaired electrons are present in $e_{g}$ orbital of $\mathrm{MnO}_{4} \Theta$.

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7. How many electrons are present in $d_{z 2}$ orbital of $\left[\mathrm{Ni}(\mathrm{gly})_{2}\right]$ ? .

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8. Give the total number of $t_{2 g}$ and $e_{g}$ electrons in $\left[\mathrm{NiF}_{6}\right]^{2-}$.

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9. How many electrons are present in d-orbitals which are present along the axis in $\left[\mathrm{Ti}^{\left.\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+} \text { ?. } . ~ . ~ . ~}\right.$

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10. If Hund' s rule is violated then how many unpaired electrons are present In $\left[\operatorname{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$ complex ion ?.

## - Watch Video Solution

11. Give the number of unpaired electrons in $t_{2 g}$ set of d-orbitals in $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{3} \mathrm{~F}_{3}\right]$ complex .

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12. How many maximum atom (s)is//are are present in same plane of $\mathrm{Cr}(\mathrm{CO})_{6}$ ?.

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13. Find out the number of hydrogen bonds present in the structure of the nickel dimethylglyoxime complex .

## Exercises Fill The Blanks

1. In a coordination complex the negative groups or neutral molecules attached to the central atoms are termed as $\qquad$ .

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2. Fill in the blanks :

According to Werner's coordination theory, there are kinds of valency, $\qquad$ and $\qquad$ . The primary valency of a central metal ion is satisfied with $\qquad$ .

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3. A ligand is termed as monodentate, didentate etc, depending upon the $\qquad$ present in it .

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4. The number of ligands attached to the central atom is termed the of the central atom.

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5. The total number of electrons on the central atom including those gained by bonding is called the $\qquad$ abbreviated as $\qquad$ .

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6. Coordination isomerism occurs when both cation and anion are $\qquad$ .
7. The magnitude of stability constant gives an indication of the stability of $\qquad$ in $\qquad$ .

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8. Under the influence of strong the ligands the electrons can be forced $\qquad$ against the $\qquad$ rule of $\qquad$ .

## - Watch Video Solution

9. $d_{x 2}, d_{y z}$ and $d_{z x}$ orbitals have $\qquad$ energies and are collectively termed $\qquad$ or $\qquad$ or $\qquad$ orbitals .

## - Watch Video Solution

10. $d_{x y}, d_{y z}$ and $d_{z x}$ orbitals have $\qquad$ termed $\qquad$ or $\qquad$ orbitals .

## - Watch Video Solution

11. Organometallic compounds are those compounds which contain one or more $\qquad$ .

## - Watch Video Solution

12. $d^{2} s p^{3}$ hybridisation of the central atom gives the $\qquad$ orbital complex while $s p^{3} d^{2}$ hybridisation gives the $\qquad$ orbital complex .

## - Watch Video Solution

13. Wilkinson's catalyst, unsed as a catalyst in the hydrogenation of alkene is_______and is an example of $\qquad$ catalysis .
14. Recently the platinum complex known as cisplatin has been found in the treatment of $\qquad$ and is represented as $\qquad$ .

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15. Ziegker-Natta catalyst, used as a catalyst for the low temperature polmerisation al alkene is an example of____catalysis and is represented as $\qquad$ .

## Watch Video Solution

16. Zeisse's-salt Ferrocene and Dibenzene chromium are the example of bonded organometallic compounds.
17. Calcium dihydrogen salt of $E D T A$ is used as an antidote for the poisoning of $\qquad$ .

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18. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{SO}_{4}\right] \mathrm{Br}$ and $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Br}\right] \mathrm{SO}_{4}$ shown $\qquad$

## - Watch Video Solution

19. According to valence bond theory the geometry of $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$ is $\qquad$ .

## - Watch Video Solution

20. $\mathrm{K}_{4} \mathrm{Fe}(\mathrm{CO})_{6}$ is considered to a be a complex but potash alum is $\qquad$ and bleaching powder is $\qquad$ .
21. Grignard reagent is a $\qquad$ organometallic compound .

## - Watch Video Solution

22. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$ is diamagnetic while $\left[\mathrm{CoF}_{6}\right]^{3-}$ is $\qquad$

## - Watch Video Solution

23. $[\text { ptabcd }]^{n \pm}$ has $\qquad$ shape and has $\qquad$ geometrical isomers .

## - Watch Video Solution

24. Geomerical isomerism is not observed in complexes of coordination number 4 of geometry .

## - Watch Video Solution

25. Trans form of $\left[M(A A)_{2} a_{2}\right]^{n+}$ complex does not show isomerism .

## - Watch Video Solution

26. Dimethylglyoxime is used from the gravimetic estimation of $\qquad$ ion.

## - Watch Video Solution

27. EDTA is used as a complexing agent in $\qquad$ estimation of metal ions like $\mathrm{Ca}^{2+}, \mathrm{M}^{2+}$ and $\mathrm{Zn}^{2+}$ ions.

## - Watch Video Solution

28. Potassium hexanitrocobaltate III $\mathrm{K}_{3}\left[\mathrm{Co}\left(\mathrm{NO}_{2}\right)_{6}\right]$ is called $\qquad$ .
29. Haemoglobin is a complex of $\qquad$ chlorophyll is a complex of and vitamin $B_{12}$ is a complex of $\qquad$ .

## - Watch Video Solution

30. Organo arsenic compounds are used as remedy for $\qquad$ .

## - Watch Video Solution

31. $\qquad$ is used to prevent the infection of young plants.

## - Watch Video Solution

32. $\qquad$ is an important anti knock compound added to petrol used in internal combustion engines .

## - Watch Video Solution

1. Write true or false.A bidentate ligand has 3 coordination sites .

## - Watch Video Solution

2. Tetrahedral complex cannot show geometrical isomerism .

## - Watch Video Solution

3. Write true or false Coordination number and oxidation state of a metal means the same thing.

## - Watch Video Solution

4. Coordination compounds are mainly known for transition metals .
5. Write true or false: Ambidentate ligands can show linkage isomerism .

## - Watch Video Solution

6. Write true or false: $\mathrm{Fe}(\mathrm{CO})_{5}$ has trigonal bipyramidal geometry .

## - Watch Video Solution

7. Using valence bond theory of complexes explain the geometry and diamagnetic nature of the ion, $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$.

## - Watch Video Solution

8. Valence bond theory explains the colour of the coordination compounds .
9. Stability of coordination compounds increases with increase in charge density of the metal ions.

## ( Watch Video Solution

10. Write true or false: $\left[\mathrm{NiCI}_{4}\right]^{2-}$ is diamagnetic in nature .

## - Watch Video Solution

11. The pair $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right] \mathrm{CI}_{3}$ and $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4} \mathrm{CI}_{2}\right] C I . \mathrm{H}_{2} \mathrm{O}$ shows ionisation isomerism .

## ( Watch Video Solution

12. Write true or false: $E A N$ rule is followed by $K_{4} \mathrm{Fe}(C N)_{6}$ complex .
13. A: $A I_{2}\left(\mathrm{CH}_{3}\right)_{6}$ is a dimeric compound and has Similar structure to diborane. R: $\mathrm{AI}_{2}\left(\mathrm{CH}_{3}\right)_{6}$ in a sigma bonded complex

## - Watch Video Solution

14. Write true or false Carbonyl complex are organometallic compounds .

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## Archives (Linked Comprehension)

1. The coordination number of $\mathrm{Ni}^{2+}$ is 4
$\mathrm{NiCI}_{2}+\mathrm{KCN}$ (excess)rarrA (cyano complex)
$\mathrm{NiCI}_{2}+$ conc. HCI (excess) rarr B (Chloro complex)
The IUPAC name of $A$ and $B$ are .
A. potassium tetracyanonickelate(II),potassium tetrachloronickelate(II)
B. tetracyanopotassiumnickelate(II)tetrrachloropotassiumnickelate(II) .
C. tetracyanonickel(II) tetrachloronickel(II)
D. potassium tetracyanonickel(II),tetracholoronickel(II) .

## Answer: a

## - Watch Video Solution

2. The coordination number of $\mathrm{Ni}^{2+}$ is 4
$\mathrm{NiCI}_{2}+K C N$ (excess)rarrA (cyano complex)
Predict the magnetic nature of $A$.
A. $A$ is para magnetic .
B. $A$ is diamagnetic
C.
D. None

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3. The coordination number of $\mathrm{Ni}^{2+}$ is 4

## $\mathrm{NiCI}_{2}+K C N$ (excess)rarrA (cyano complex)

The hybridisation of $A$ and $B$ are .
A. $d s p^{2}, s p^{3}$
B. $s p^{3}, s p^{3}$
C. $d s p^{2}, d s p^{2}$
D. $s p^{3}, d^{2}, d^{2} s p^{3}$.

## Answer: a

4. An aqueous solution of metal ion MI reacts separately with reagents $Q$ and $R$ in excess to give tetrahedral and square planar complexes, respectively An aqueous solution of another metal ion $M 2$ always forms tetrahedral complexs with theses reagents. Aqueous solution of $M 2$ on reaction with reagent $S$ gives white precipitate which dissolves in excess of $S$ The reactions are summarised in the scheme given below: SCHEME :

Tetrahedral $\stackrel{\mathrm{Q}}{\stackrel{\mathrm{excess}}{ }} \mathbf{M 1} \xrightarrow[\text { excess }]{\mathrm{R}}$ Square Planar

White precipitate $\underset{\text { excess }}{\text { s }}$ precipitate dissolves

What is M2

## - Watch Video Solution

5. An aqueous solution of metal ion MI reacts separately with reagents $Q$ and $R$ in excess to give tetrahedral and square planar complexes, respectively An aqueous solution of another metal ion $M 2$ always forms tetrahedral complexs with theses reagents. Aqueous solution of $M 2$ on
reaction with reagent $S$ gives white precipitate which dissolves in excess of $S$ The reactions are summarised in the scheme given below: SCHEME :

Tetrahedrall $\underset{\text { excess }}{\stackrel{Q}{M}} \underset{\substack{\text { excess }}}{\mathrm{R}}$ Tetrahedral
White precipitate $\xrightarrow[\text { excess }]{\text { S }}$ precipitate dissolves

What is $s$ ?
A. $K_{4}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]$
B. $\mathrm{Na}_{2} \mathrm{HPO}_{4}$
C. $\mathrm{K}_{2} \mathrm{CrO}_{4}$
D. KOH

## Answer: Double salt

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1. The pair of coordination complexes//ion exhibiting the same kind of isomerism is (are).
A. a. $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{Cl}\right] \mathrm{Cl}_{2}$ and $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{Cl}_{2}\right] \mathrm{Cl}$
B. b. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{Cl}_{2}\right]^{\oplus}$ and $\left[\mathrm{Pt}\left(\mathrm{NH}_{3}\right)_{2}\left(\mathrm{H}_{2} \mathrm{O}\right) \mathrm{Cl}\right]^{\oplus}$
C. c. $\left[\mathrm{CoBr}_{2} \mathrm{Cl}_{2}\right]^{2-}$ and $\left[\mathrm{PtBr}_{2} \mathrm{Cl}_{2}\right]^{2-}$
D. d. $\left[\mathrm{Pt}\left(\mathrm{NH}_{3}\right)_{3}\left(\mathrm{NO}_{3}\right)\right] \mathrm{Cl}$ and $\left[\mathrm{Pt}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{Cl}\right] \mathrm{Br}$

Answer: b,d

## - Watch Video Solution

## Archives Single Correct

1. Among $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right],\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-},\left[\mathrm{NiCl}_{2}\right]^{2-}$ species, the hybridisation
${ }^{*}$ states of the Ni atom are, respectively (At. No . of $\mathrm{Ni}=28$ )
A. $n i(\mathrm{CO})_{4}$ and $\mathrm{NiCI}_{4}^{2-}$ are diamagnetic and $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ is paramagnetic.
B. $\mathrm{NiCI}_{4}^{2-}$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}^{2-}\right.$ are diamagnetic and $\mathrm{Ni}(\mathrm{CO})_{4}$ is paramagnetic.
C. $\mathrm{NiCl}_{4}^{2-}$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}^{2-}\right.$ are diamagnetic and $\left[\mathrm{Ni}(\mathrm{CO})_{4}^{2-}\right.$ is paramagnetic.
D. $\mathrm{Ni}(\mathrm{CO})_{4}$ is diamagnetic and $\mathrm{NiCl}_{4}^{2-}$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ are paramagnetic.

## Answer: c

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2. Among the following ions which has the highest paramagntism ? .
A. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$
B. $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$
C. $\left[\mathrm{Cu}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$
D. $\left[\mathrm{Zn}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$

## Answer: b

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3. Which of the following is formed when excess of KCN is added to an aqueous solution of copper sulphate?
A. $\mathrm{Cu}(\mathrm{CN})_{2}$
B. $\mathrm{K}_{2}\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]$
C. $K\left[\mathrm{Cu}(\mathrm{CN})_{2}\right]$
D. $K_{3}\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]$

## Answer: Double salt

4. The geometry of $\mathrm{Ni}(\mathrm{CO})_{4}$ and $\mathrm{Ni}\left(\mathrm{PPh}_{3}\right) \mathrm{Cl}_{2}$ are
A. Both square planar
B. Tetrahedral and square planar,respectively
C. Both tetrahedral
D. Square planar and tetrahedral,respectively

## Answer: c

## - Watch Video Solution

5. Which of the following species has an atom with +6 oxidation state?
A. $\mathrm{MnO}_{4}^{\Theta}$
B. $\mathrm{Cr}(\mathrm{CN})_{6}^{3-}$
C. $N i F_{6}^{2-}$
D. $\mathrm{CrO}_{2} \mathrm{CI}_{2}$

## Answer: Double salt

## - Watch Video Solution

6. The complex which has no d-electron in the central metal atom is .
A. $\left[\mathrm{MnO}_{4}\right]^{\Theta}$
B. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+}$
C. $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{3-}$
D. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$

## Answer: a

## D Watch Video Solution

7. The pair of compounds having metals in their highest oxidation state is
A. $\mathrm{MnO}_{2}, \mathrm{FeCI}_{3}$
B. $\left[\mathrm{MnO}_{4}\right]^{\Theta}, \mathrm{CrO}_{2} \mathrm{CI}_{2}$
c. $\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]^{3-},\left[\mathrm{Co}(\mathrm{CN})_{6}\right]^{3-}$
D. $\left[\mathrm{NiCI}_{4}\right]^{2-},\left[\mathrm{CoCI}_{4}\right]^{\Theta}$

## Answer: b

## - Watch Video Solution

8. The compound having a tetrahedral geometry is .
A. $\left[\mathrm{Ni}\left(\mathrm{CN}_{4}\right)\right]^{2-}$
B. $\left[\operatorname{Pd}(\mathrm{CN})_{4}\right]^{2-}$
C. $\left[P d C I_{4}\right]^{2-}$
D. $\left[\mathrm{NiCI}_{4}\right]^{2-}$

## Answer: Double salt

9. Spin only magnetic moment in B.M. of the compound $\mathrm{Hg}(\mathrm{II})\left[\mathrm{Co}(\mathrm{SCN})_{4}\right]$ is-
A. $\sqrt{3}$
B. $\sqrt{15}$
C. $\sqrt{24}$
D. $\sqrt{8}$

## Answer: b

## Watch Video Solution

10. Which kind of isomerism is exhibited by the octahedral complex,

$$
\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{Br}_{2}\right] \mathrm{Cl} \text { ? }
$$

A. geometrical and ionisation
B. geometrical and optical
C. optical and ionisation
D. geometrical only

## Answer: a

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11. The bond length of $C-O$ bond in carbon monoxide is $1.128 A$ The $C-O$ bond length in $\left[\mathrm{Fe}(\mathrm{CO})_{5}\right]$ is .
A. $1.15 A$
B. $1.128 A$
C. $1.13 A$
D. $1.118 A$

## Answer: c

## - Watch Video Solution

12. Among the following metal carbonyls, the bond order is lowest in :
A. $\left[\mathrm{Mn}(\mathrm{CO})_{6}\right]^{\oplus}$
B. $\left[\mathrm{Fe}(\mathrm{CO})_{5}\right]$
C. $\left[\operatorname{Cr}(\mathrm{CO})_{6}\right]$
D. $\left[V(C O)_{6}\right]{ }^{\Theta}$

Answer: b

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13. Both $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$ and $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ are diamagnetic The hybridisations of nickel in these complexes, respectively are :
A. $s p^{3}, s p^{3}$
B. $s p^{3}, d s p^{2}$
C. $d s p^{2}, s p^{3}$
D. $d s p^{2}, d s p^{2}$

## Answer: b

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14. The IUPAC name of $\left[\mathrm{Ni}\left(\mathrm{NH}_{3}\right)_{4}\right]\left[\mathrm{NiCl}_{4}\right]$ is
A. tetrachloronickel (II)-tetraaminenickel(II)
B. tetrachloronickel (II)-tetraaminenickel(II)
C. tetrachloronickel (II)-tetraaminenickel(II)
D. tetrachloronickel (II)-tetraaminenickel(II)

## Answer: c

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15. Among the following the coloured compound is
A. CuCI
B. $K_{3}\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]$
C. $\mathrm{CuF}_{2}$
D. $\left[\mathrm{Cu}\left(\mathrm{CH}_{3} \mathrm{CN}\right)_{4}\right] \mathrm{BF}_{4}$

## Answer: c

## - Watch Video Solution

16. The correct structure of ethylenediaminetetraacetic acid (EDTAH)

B.

C.

D.


## Answer: c

17. The ionization isomer of $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4} \mathrm{Cl}\left(\mathrm{NO}_{2}\right)\right] \mathrm{Cl}$ is
A. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4}\left(\mathrm{O}_{2} \mathrm{~N}\right)\right] \mathrm{CI}_{2}$
B. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4} \mathrm{CI}_{2}\right]\left(\mathrm{NO}_{2}\right.$
c. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4} \mathrm{CI}(\mathrm{ONO})\right] C I$
D. $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4} \mathrm{CI}_{2}\left(\mathrm{NO}_{2}\right)\right] \mathrm{H}_{2} \mathrm{O}$

Answer: b

## - Watch Video Solution

18. The complex showing a spin -magnetic momnet of $2.82 B M$ is .
A. $\mathrm{Ni}(\mathrm{CO})_{4}$
B. $\left[\mathrm{NiCI}_{4}\right]^{2-}$
C. $\mathrm{Ni}\left(\mathrm{PPh}_{3}\right)_{4}$
D. $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$

## Answer: d

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19. Geometrical shapes of the complexes formed by the reaction of $\mathrm{Ni}^{2+}$ with $\mathrm{H} 2 \mathrm{O}, \mathrm{Cl}^{-}$, and $\mathrm{CN}^{-}$, respectively are
A. Octahedral tetrahedral and square planar
B. Tetrahedral,square planar and octahedral
C. Square planar,tetrahedral,octahedral
D. Octahedral,square palnar and octahedral

## Answer: b

20. 

$(\mathrm{K}-\mathrm{P}): \mathrm{K}_{3}\left[\mathrm{Fe}(\mathrm{CN})_{6}\right]-\mathrm{K},\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right] \mathrm{Cl}_{3}-\mathrm{L}, \mathrm{Na}_{3}\left[\mathrm{Co}(\text { oxalate })_{3}\right]-\mathrm{M},\left[\mathrm{Ni}\left(\mathrm{H}_{2}\right.\right.$
the diamagnetic complexes are
A. $K, L, M, N$
B. $K, M, O, P$
C. $L, M, O, P$
D. $L, M, N, O$

## Answer: c

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21. As per IUPAC nomenclature, the name of the complex, $\left[\mathrm{Co}\left(\mathrm{H}_{2} \mathrm{O}\right)_{4}\left(\mathrm{NH}_{3}\right)_{2}\right] \mathrm{Cl}_{3}$ is
A. Tetaaquadiaminecobalt(III) chloride .
B. Tetaaquadiaminecobalt(III) chloride .
C. Tetaaquadiaminecobalt(III) chloride .
D. Tetaaquadiaminecobalt(III) chloride .

## Answer: d

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22. The colour of light absobed by an aqueous solution of $\mathrm{CuSO}_{4}$ is
A. orange-red
B. blue-green
C. yellow
D. violet

## Answer: a

23. $\left[\mathrm{NiCI}_{2}\left\{P\left(\mathrm{C}_{2} \mathrm{H}_{5}\right)_{2}\left(\mathrm{C}_{6} \mathrm{H}_{5}\right)\right\}_{2}\right]$ exhibits temperature dependent magnetic behaviour(paramagnetic//diamagnetic) The coordination geometries of $\mathrm{Ni}^{2+}$ in the paramagnetic and diamagnetic states are respectively.
A. Tetrahedral and tetrahedral
B. Square planar and square planar
C. Tetrahedral and square planar
D. Square planar and tetrahedral

## Answer: c

## - Watch Video Solution

24. Which of the following complex species is not expected to exhibit optical isomerism?
A. $\left[\mathrm{Co}(e n)_{2} \mathrm{CI}_{2}\right]^{\oplus}$
B. $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{3} \mathrm{CI}_{3}\right]$
c. $\left[\mathrm{Co}(\mathrm{en})\left(\mathrm{NH}_{3}\right)_{2} \mathrm{CI}_{2}\right]^{\oplus}$
D. $\left[\mathrm{Co}(\mathrm{en})_{3}\right]^{3+}$

## Answer: b

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25. Consider the follwing complexes ion $P, Q$ and $R$
$P=\left[\mathrm{FeF}_{6}\right]^{3-}, Q=\left[V\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$ and $R=\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$
The correct order of the complex ions, according to their spin only magnetic moment values (inBM) is .
A. $R<Q>R$
B. $Q<R<P$
C. $R<P<Q$
D. $Q<P<R$

## D Watch Video Solution

26. If excess of $\mathrm{AgNO}_{3}$ solution is added to 100 mL of a 0.024 M solution of dichlorobis (ethylenediamine ) cobalt (III) chloride, how many moles of AgCl be precipitated?
A. 0.003
B. 0.01
C. 0.0001
D. 0.002

## Answer: c

27. The octahedral complex of a metal ion $M^{3+}$ with four monodentate ligands $L_{1}, L_{2}, L_{3}$ and $L_{4}$ absorb wavelengths in the region of red greee, yellowand blue, respectively. The incresing order of ligand strength of the four ligands is:
A. $L_{3}<L_{2}<L_{4}<L_{1}$
B. $L_{1}<L_{2}<L_{4}<L_{3}$
C. $L_{4}<L_{3}<L_{2}<L_{1}$
D. $L_{1}<L_{3}<L_{2}<L_{4}$

## Answer: d

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28. The equation which is balanced and represents the correct product(s) is:
A. $\left[\mathrm{Mg}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}+(E D T A)^{4-} \xrightarrow{\text { ExcessNaOH }}[\mathrm{Mg}(\text { EDTA })]^{2+}+6 \mathrm{H}_{2} \mathrm{O}$
B. $\mathrm{CuSO}_{4}+4 \mathrm{KCN} \rightarrow \mathrm{K}_{2}\left[\mathrm{Cu}(\mathrm{CN})_{4}\right]+\mathrm{K}_{2} \mathrm{SO}_{4}$
C. $\mathrm{Li}_{2} \mathrm{O}+2 \mathrm{KCI} \rightarrow 2 \mathrm{LiCI}+\mathrm{K}_{2} \mathrm{O}$
D. $\left[\mathrm{CuCI}\left(\mathrm{NH}_{3}\right)_{5}\right]^{\oplus}+5 \mathrm{H}^{\oplus} \rightarrow \mathrm{Co}^{2+}+5 \mathrm{NH}_{4}^{\oplus}+\mathrm{CI}^{\Theta}$

## Answer: d

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## Archives Assertion Reasoning

1. Assertion $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{5} \mathrm{NO}\right] \mathrm{SO}_{4}$ is paramagnetic Reason The Fe in $\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{5} \mathrm{NO}\right] \mathrm{SO}_{4}$ has three unpaired electrons.
A. Stament I is true, Statement II is also true Statement II is a correct explanation for Statement I .
B. Statement I is true Statement II is false.
C. Statement I is false, Statement II is true .

## D.

## Answer: a

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2. Statement I The geometrical isomer of the complex $\left.\left[\mathrm{M}(\mathrm{NH})_{3}\right)_{4} \mathrm{CI}_{2}\right]$ are optically inactive

Satement II Both geometrical isomers of the complex $\left[\mathrm{M}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2}\right]$ possess axis of symmetry.
A. Stament I is true, Statement II is also true Statement II is a correct explanation for Statement I.
B. Statement I is true Statement II is false.
C. Statement I is false, Statement II is true .
D. Stament I is true, Statement II is also true Statement II is not a correct explanation for Statement I .

## Answer: a

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## Archives Integer

1. The volume (in mL ) of $0.1 \mathrm{MAgNO}_{3}$ required for complete precipitation of chloride ions present in 30 mL of 0.01 M solution of $\left[\mathrm{Cr}\left(\mathrm{H}_{2} \mathrm{O}\right)_{5} \mathrm{Cl}\right] \mathrm{Cl}_{2}$, as silver chloride is close to:

## - Watch Video Solution

2. $E D T A^{4-}$ i9s ethylenediamine tetraacetate ion The total number of $N-C O-O$ bond angles in $[\operatorname{Co}(E D T A)]^{-1}$ complex ion is .

## - Watch Video Solution

1. AgCI dissolves in excess of $K C N$ solution to give the $\qquad$ complex compound.

## - Watch Video Solution

2. The type of magnetism exhibited by $\left[\mathrm{Mo}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}$ ion is $\qquad$ .

## - Watch Video Solution

3. The IUPAC name of $\left[\mathrm{CO}\left(\mathrm{NH}_{2}\right)_{6}\right] C I_{3}$ is $\qquad$

## - Watch Video Solution

Archives True/False

1. Both potassium ferrocyanide and potassium ferricyanide are diamagnetic.

## - Watch Video Solution

## Archives Subjective

1. Write the balanced chemical equations for the following "Potassium ferricyanide reacts with hydrogen peroxide in basic solution" .

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2. Give reasons in two or three sentences only for the following
"The species $\left[\mathrm{CuCI}_{4}\right]^{2-}$ exitsts, while $\left[\mathrm{CuI}_{4}\right]^{2-}$ does not".

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3. The acidic aqueous solution of ferrous ion forms a brown complex in the presence of $\mathrm{NO}_{3}^{\Theta}$ by the follwing two steps:
$\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}+\mathrm{NO}_{3}^{\Theta}+\mathrm{H}^{\oplus} \rightarrow \ldots+\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}+\mathrm{H}_{2} \mathrm{O}$
$\left[\mathrm{Fe}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{2+}+\ldots \rightarrow \ldots+\mathrm{H}_{2} \mathrm{O}$
Complete and balance the equations .

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4. Identify the complexes which are expected to be coloured.
a. $\left[\mathrm{Ti}\left(\mathrm{NO}_{3}\right)_{4}\right]$, b. $\left[\mathrm{Cu}\left(\mathrm{NCCH}_{3}\right)_{4}\right]{ }^{\oplus} \mathrm{BF}_{4}^{\ominus}$
c. $\left[\operatorname{Cr}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+} 3 \mathrm{Cl}^{\ominus}$, d. $\mathrm{K}_{3}\left[V F_{6}\right]$

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5. Write the IUPAC name for the following compounds
(a) $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{ONO}\right] \mathrm{Cl}_{2}$
(b) $K_{3}\left[\operatorname{Cr}(C N)_{6}\right]$.

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6. Write the IUPAC name for $\left[\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{5} \mathrm{CO}_{3}\right] \mathrm{CI}$.

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7. Write a balanced equation for the reaction of argentite with $K C N$ and name the products in the solution.

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8. Write the formulae of the following complexes
(a) Pentamminechlorocobalt(III) ion
(b) Lithiumtetrahydridoaluminate(III) .
9. $A, B$ and $C$ are three complexes of chromium(III) with the empirical formula $\mathrm{H}_{12} \mathrm{O}_{6} \mathrm{Cl}_{3} \mathrm{Cr}$ All the three complexes not react with concentrated $\mathrm{H}_{2} \mathrm{SO}_{4}$ whereas complexes $B$ and $C$ lose $6.75 \%$ and $13.5 \%$ of their original mass respectively, on treatment on treatment with conectrated $\mathrm{H}_{2} \mathrm{SO}_{4}$ Identify $A, B$ and $C$.

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10. An aqueous solution containing one mole of $\mathrm{HgI}_{2}$ and two moles of NaI is orange in colour. On addition of excess Nal the solution becomes colourless. The orange colour reappears on subsequent addition of NaOCl . Explain with equation.

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11. Draw the structures of $\left[\mathrm{Co}\left(\mathrm{NH}_{3}\right)_{6}\right]^{3+},\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$ and $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$ Write the hybridisation of atomic orbitals of the transition metal in each

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12. A metal complex having composition $\mathrm{Cr}\left(\mathrm{NH}_{3}\right)_{4} \mathrm{CI}_{2} \mathrm{Br}$ has been isolated in two forms A and B. The form A reacts with $\mathrm{AgNO}_{3}$ to give a white precipitate readily soluble in dilute aqueous ammonia whereas B gives a pale yellow precipitate soluble in concentrated ammonia.
(i) Write the formulae of isomers A and B .
(ii) State the hybridisation of chromium in each of them.
(iii) Calculate the magnetic moment (spin only) of the isomer A .

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13. The magnitude of magnetic moment (spin only ) of $\left[\mathrm{NiCl}_{4}\right]^{2-}$ will be

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14. Write the IUPAC nomenclature of the given complex along with its hybridisation and structure $\mathrm{K}_{2}\left[\mathrm{Cr}(\mathrm{NO})\left(\mathrm{NH}_{3}\right)(\mathrm{CN})_{4}\right], \mu=1.73 \mathrm{~B} . \mathrm{M}$

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15. $\mathrm{NiCl}_{2}$ in the presence of dimethyl glyoxime (DMG) gives a complex with precipitates in the presence of $\mathrm{NH}_{4} \mathrm{OH}$, giving a bright red colour.
(i) Draw its structure and show H - bonding
(ii) Give oxidation state of Ni and its hybridisation.
(iii) Predict whether it is paramagnetic or diamagnetic .

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16. Aluminium trifluoride is insoluble in anhydrous HF but dissolves on addition of NaF . Aluminium trifluoride precipitates out of the resulting solution when gaseous $\mathrm{BF}_{3}$ is bubbled through. Give reasons.
17. Write the balanced chemical equations for developing a black and white photographic film Also, give the reason as to why the solution of sodium thiosulphate on acidification turns milky white and give the balanced chemical equation of this reaction.

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18. $\mathrm{Fe}^{3+} \xrightarrow{\text { SNC }^{\Theta} \text { (Excess) }}$ ABloodred $\xrightarrow{F^{\ominus \text { Excess }}}$ BColourless
Identify $A$ and $B$

Write the IUPAC name of $A$ and $B$

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