

<ul style="list-style-type: none">• Explain the following terms or concepts.	Marks 1
Lewis base	

- Give the oxidation number of the indicated atom in the following compounds.

2

Compound	Atom	Oxidation number
HNO_2	N	
NI_3	N	
$[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$	Co	
$\text{K}_3[\text{CrCl}_6]$	Cr	

- Write down the formulas for the following compounds.

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Compound	Formula
hexaaquacobalt(II) carbonate	
tetraamminecopper(II) sulfate	
ammonium hexafluoridoferrate(III)	
potassium hexacyanidomanganate(II)	

THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.

- The K_{sp} of AgBr is 5.0×10^{-13} . The K_{stab} of $[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}$ is 4.7×10^{13} . Calculate the value of the equilibrium constant for the dissolution of AgBr in $\text{Na}_2\text{S}_2\text{O}_3$ solution.

Marks
7

Answer:

Calculate the solubility of AgBr in 2.0 M $\text{Na}_2\text{S}_2\text{O}_3$.

Answer:

The K_{stab} for $[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}$ is much greater than the K_{stab} for $[\text{Ag}(\text{NH}_3)_2]^+$. Explain why this is so.

Marks
9

- Complete the following table.

Coordination compound	Oxidation number of transition metal	Number of <i>d</i> electrons around transition metal	Arrangement of <i>d</i> electrons
$K_2[PtCl_4]$			
$Na[MnO_4]$			
$(NH_4)_2[CoCl_4]$			
$[Cr(NH_3)_5(OH_2)]Cl_3$			

Identify one paramagnetic and one diamagnetic species from the above table.

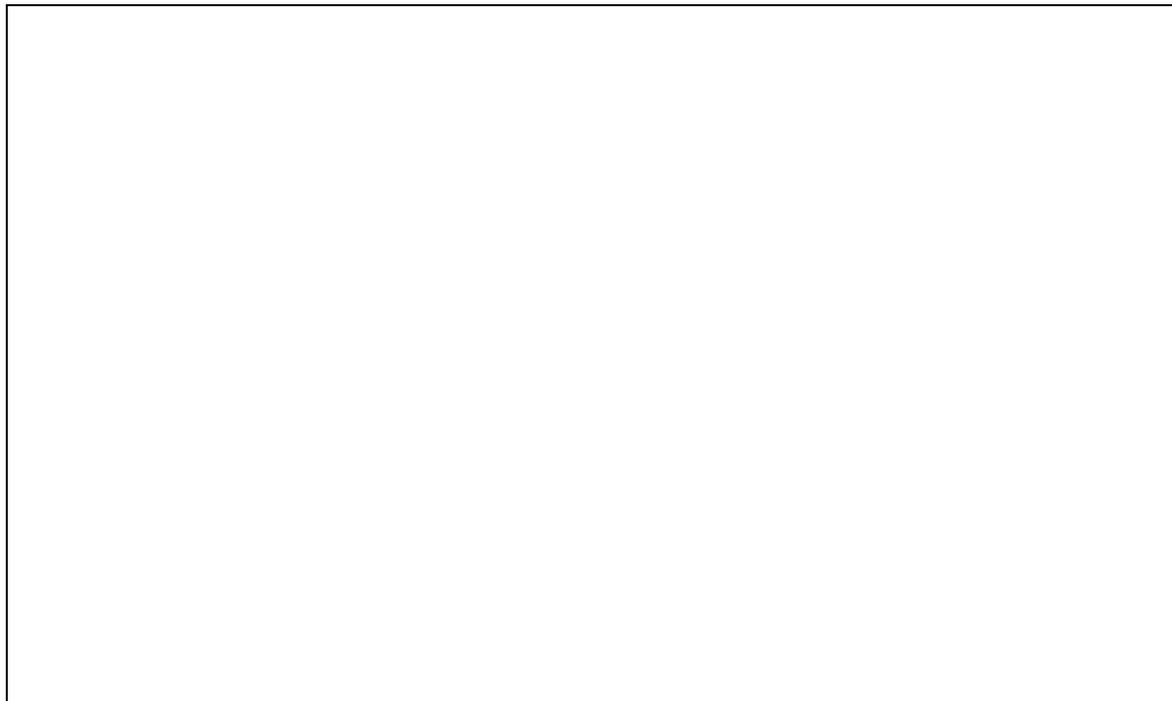
Paramagnetic:	Diamagnetic:
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- Give the equilibrium concentration of $\text{Ni}^{2+}(\text{aq})$ ions in a solution formed by dissolving 0.15 mol of NiCl_2 in 0.500 L of 2.00 M KCN solution. The K_{stab} of $[\text{Ni}(\text{CN})_4]^{2-} = 1.7 \times 10^{30}$.

Answer:

Marks
4

- Draw all stereoisomers of the complex ion of $[\text{CoCl}_2(\text{en})_2]\text{Cl}$. Label the non-optically active isomer with its systematic name.
(en = ethylenediamine = 1,2-ethanediamine = $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$)



- What is a dative bond and does it differ from a covalent bond? Use examples from coordination chemistry and elsewhere to illustrate your answer.

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- Explain why iron storage proteins are necessary for the transport of iron both intracellularly and extracellularly within the bloodstream at a pH of 7.4.

2

Marks
7

- Write out the full name in standard notation of $[\text{Co}(\text{NH}_3)_4(\text{SCN})_2]\text{Cl}$ and draw all the possible isomers of the complex ion.

Describe and contrast the nature of the chemical bonds:

- (a) between N and H in NH_3 ;
- (b) between Co and NH_3 ; and
- (c) between $[\text{Co}(\text{NH}_3)_4(\text{SCN})_2]$ and Cl in this compound.

- During lectures a demonstration was performed called the “One pot experiment”. In this experiment, silver ions reacted with an alternating series of anions and ligands to form insoluble precipitates and soluble complexes. Explain how an insoluble precipitate can possibly be “dissolved” by the addition of ligands to the solution.

2

Marks
4

- The general formula for a nickel(II) chloride compound complexed with ammonia is $[\text{Ni}(\text{NH}_3)_x]\text{Cl}_2$. A 0.59 g sample of the salt was dissolved in water and the ammonia from it was titrated with 153 mL of 0.100 M HCl. What is the value of the coefficient x ?

Answer:

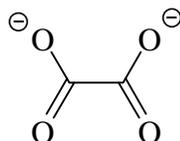
Marks
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- Can methane act as a ligand? Explain your answer.

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4

- Fe(II) generally forms octahedral complexes. How many different complex ions can be formed when $\text{Fe}(\text{NO}_3)_2$ is dissolved in an aqueous solution of sodium oxalate? The structure of the oxalate ligand is shown below.



Answer:

Draw diagrams of any 3 of these complexes, including at least one that is chiral.

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- Complete the following table.

4

Formula	Systematic name
$[\text{CrCl}(\text{NH}_3)_5]\text{Cl}_2$	
	dibromidotetracarbonylplatinum(IV) nitrite
$\text{K}_3[\text{CrF}_6]$	
$(\text{NH}_4)_3[\text{CuF}_5(\text{OH}_2)]$	

- State two chemical factors that contribute to the bioavailability of a heavy metal in the human body.

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Marks
5

- Cisplatin, $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$, is a particularly effective chemotherapy agent against certain types of cancer. Calculate the concentration of $\text{Pt}^{2+}(\text{aq})$ ions in solution when 0.075 mol of cisplatin is dissolved in 1.00 L of a 1.00 M solution of NH_3 .
 K_{stab} of $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2] = 3.4 \times 10^{12}$.

Answer:

What changes would occur to the values of K_{stab} for cisplatin and the concentration of $\text{Pt}^{2+}(\text{aq})$ ions if solid KCl were dissolved in the above solution?

K_{stab}	increase	no change	decrease
$[\text{Pt}^{2+}(\text{aq})]$	increase	no change	decrease

- Draw all possible stereoisomers of the complex ion $[\text{CoCl}_2(\text{en})_2]^+$. Label each as *cis* or *trans*. en = ethylenediamine = $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$

3

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- Name the following complexes.

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Marks
3

- Zinc sulfate (0.50 g) is dissolved in 1.0 L of a 1.0 M solution of KCN. Write the chemical equation for the formation of the complex ion $[\text{Zn}(\text{CN})_4]^{2-}$.

Calculate the concentration of $\text{Zn}^{2+}(\text{aq})$ in solution at equilibrium. Ignore any change in volume upon addition of the salt. K_{stab} of $[\text{Zn}(\text{CN})_4]^{2-} = 4.2 \times 10^{19} \text{ M}^{-4}$.

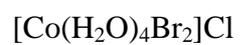
Answer:

- Draw all stereoisomers of the complex ion of $[\text{Co}(\text{en})_3]\text{Br}_3$.
(en = ethylenediamine = $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$)

2

- Name the following complexes.

2



- Write the chemical equation for the formation of the complex ion $[\text{Cd}(\text{NH}_3)_4]^{2+}$.

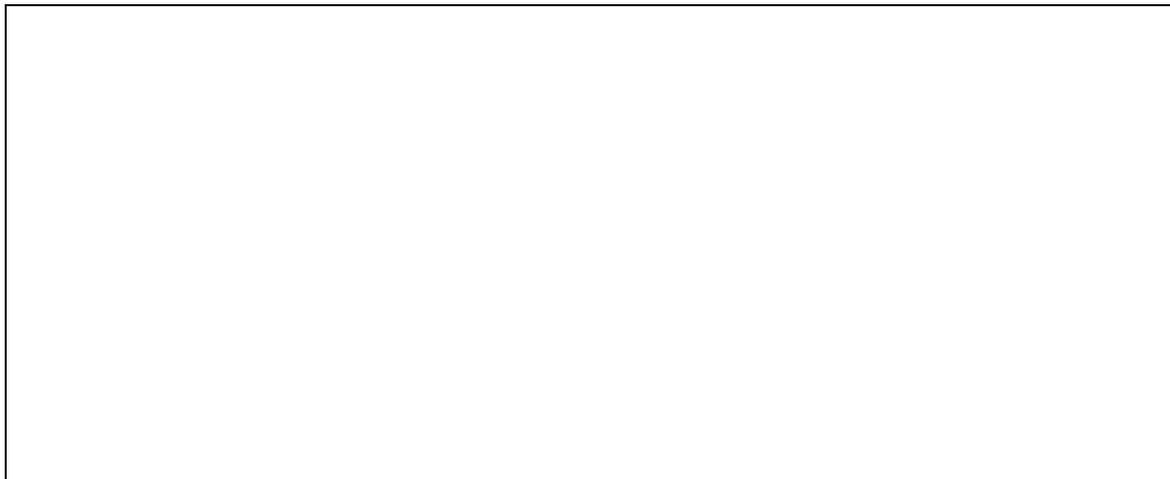
Marks
2

Write the associated stability constant expression (K_{stab}).

- Draw all of the geometric isomers for the complex ion $[\text{CoI}_2(\text{NH}_3)_4]^+$. Label each isomer with its systematic name.



- Coordination complexes can display a number of types of isomerism. Draw a simple diagram showing a pair of geometric isomers. Label your diagram with the systematic name of each isomer.



- Complete the following table.

Formula	Systematic name
$[\text{CrCl}(\text{OH}_2)_5]\text{Cl}_2$	
$\text{NH}_4\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	
	sodium hexachloridocobaltate(III)
	aluminium nitrate-9-water
	potassium nitrite
KHSO_4	

Marks
3

- Classify each of the following as either “soluble” or “insoluble” in water at 298 K.

Compound	Solubility	Compound	Solubility
$\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$		HgCl_2	
Li_2CO_3		$\text{Zn}(\text{CH}_3\text{CO}_2)_2$	
MnO_2		SrSO_4	

7

- Complete the following table.

FORMULA	SYSTEMATIC NAME
$\text{NH}_4\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	
$[\text{Cr}(\text{OH}_2)_5\text{Cl}]\text{SO}_4$	
NaH_2PO_4	
HClO_4	
As_2O_3	
$[\text{PdCl}_2(\text{NH}_3)_2]$	
SO_2	
	potassium thiocyanate
	sodium nitrite
	tetraaquadibromidocobalt(III) chloride
	sodium hexacyanidoferrate(III)
	lead(IV) oxide
	peroxide ion
	nickel(II) nitrate-6-water