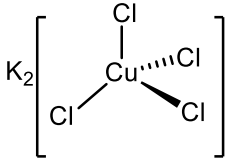


Extra practice questions for Week 4 (Transition Metals)

Question 1

Calculate the oxidation state of the transition metal in the following coordination complexes.

Coordination complex	Oxidation state
$[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]\text{Cl}$	Cl counter anion: -1 – the metal complex in brackets is +1 NH ₃ is neutral; NO ₂ is -1 $X + 4(0) + 2(-1) = +1$ X = +3
	K counter cation is +1, so the complex in brackets is -2. Each Cl is -1. $X + 4(-1) = -2$ X = +2
potassium hexacyanomanganate(II)	The answer is in the name: +2

Question 2 What is the *lanthanide contraction*?

The lanthanide contraction is the greater than expected decrease in ionic radii of the elements in the lanthanide series from atomic number 57-71. This is because of the drastic increased nuclear charge (14 extra protons).

Question 3

Provide the systematic name for the following two coordination compounds.

$[\text{Co}(\text{en})_3]^{3+}$	$[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$
tris(ethylenediamine)cobalt(III) ion	hexaamminecobalt(II) chloride

Question 4

How many valence d-electrons are there in each of the following ions?

Ion	Number of d electrons
Y^{3+}	0
Cu^+	10
Ru^{3+}	5
Zr^0	2
Fe^{2+}	6

Question 5

Which of the following octahedral complexes should have the largest crystal field splitting energy? Show or explain why.

$[\text{Cr}(\text{NH}_3)_6]^{3+}$
$[\text{Cr}(\text{CN})_6]^{3-}$
$[\text{Cr}(\text{en})_6]^{3+}$ (en = ethylenediamine)
$[\text{Cr}(\text{SCN})_6]^{3-}$
$[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$

CN⁻ has the strongest field strength of all these ligands; therefore it will cause the largest splitting.

Question 6

Which of the following ligands is most likely to form a low-spin octahedral complex with iron(III)? Show or explain why.

Br^-	SCN^-	en	OH^-	CO
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Low spin is caused by larger splitting energies, resulting from strong field ligands.

Based on the spectrochemical series, CO is the strongest field ligand.

Question 7

Which of the following ions is most likely to form colored compounds? Show or explain why.

Sc^{3+}	Cu^+	Zn^{2+}	Cr^{3+}	Ca^{2+}
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Sc^{3+} : [Ar]

Cu^+ : [Ar] 3d10

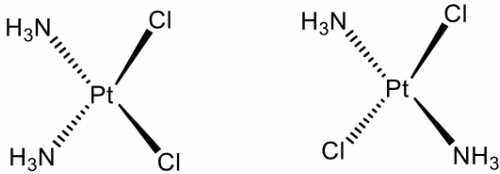
Zn^{2+} : [Ar] 3d10

Cr^{3+} : [Ar] 3d3 this is the only one with electrons in the d orbitals AND space in the d orbitals to allow for electrons to be absorbed to orbitals with a higher energy level!

Ca^{2+} : [Ar]

Question 8

Fill out the table by providing the following information for the two coordination complexes. **8 points**

	diamminedichloroplatinum(II)	$\text{Na}_2 \left[\begin{array}{c} \text{O} \quad \text{O} \\ \diagdown \quad \diagup \\ \text{N} \\ \\ \text{Zn} \\ / \quad \backslash \\ \text{NC} \quad \text{CN} \\ \\ \text{CN} \end{array} \right]$
Oxidation state	+2	+2
Coordination number	4	4
Shape	Square planar	tetrahedral
Draw isomers indicated	<p>The pair of geometric isomers</p> 	<p>Linkage isomer</p> $\text{Na}_2 \left[\begin{array}{c} \text{O} \quad \text{O} \\ \diagdown \quad \diagup \\ \text{N} \\ \\ \text{O} \\ \\ \text{Zn} \\ / \quad \backslash \\ \text{NC} \quad \text{CN} \\ \\ \text{CN} \end{array} \right]$