



Homework 7

1. Of the ten fourth-period transition metal elements in Table 8.1, which one has particularly low melting and boiling points? How can you explain this in terms of the electronic configuration of this element?
2. If *trans*-[Cr(en)₂(NCS)₂]SCN is heated, it forms gaseous ethylenediamine and solid [Cr(en)₂(NCS)₂][Cr(en)(NCS)₄]. Write a balanced chemical equation for this reaction. What are the oxidation states of the Cr ions in the reactant and in the two complex ions in the product?
3. Three different compounds are known to have the empirical formula CrCl₃·6H₂O. When exposed to a dehydrating agent, compound 1 (which is dark green) loses 2 mol water per mole of compound, compound 2 (light green) loses 1 mol water, and compound 3 (violet) loses no water. What are the probable structures of these compounds? If an excess of silver nitrate solution is added to 100.0 g of each of these compounds, what mass of silver chloride will precipitate in each case?
4. The three complex ions [Mn(CN)₆]⁵⁻, [Mn(CN)₆]⁴⁻, and [Mn(CN)₆]³⁻ have all been synthesized and all are low-spin octahedral complexes. For each complex, determine the oxidation number of Mn, the configuration of the *d* electrons (how many *t_{2g}* and how many *e_g*), and the number of unpaired electrons present.



5. Molecular nitrogen (N_2) can act as a ligand in certain coordination complexes.

Predict the structure of $[\text{V}(\text{N}_2)_6]$, which is isolated by condensing V with N_2 at 25 K.

Is this compound diamagnetic or paramagnetic? What is the formula of the carbonyl compound of vanadium that has the same number of electrons?

6. An orange–yellow osmium carbonyl compound is heated to release CO and leave elemental osmium behind. Treatment of 6.79 g of the compound releases 1.18 L $\text{CO}(g)$ at 25°C and 2.00 atm pressure. What is the empirical formula of this compound?