Calculations must be shown to get credit. Five points will be deducted if a pen is used.

\[ h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s} \]
\[ c = 2.998 \times 10^8 \text{ m/s} \]
\[ N = 6.022 \times 10^{23} / \text{mol} \]
\[ e = 1.602 \times 10^{-19} \text{ C} \]
\[ R = 8.3145 \text{ J/K} \cdot \text{mol} \]
\[ F = 96485 \text{ J/V} \cdot \text{mol} \]

1. (18 points) Name the following compounds or metal complexes.

\[
\text{[Ni(OH)\textsubscript{2}(en)\textsubscript{2}]} \\
\text{[Mn(H\textsubscript{2}O)\textsubscript{2}(NH\textsubscript{3})\textsubscript{4}]\textsuperscript{4+}} \\
\text{[Ni(CO)\textsubscript{4}]} \\
\text{Na[Fe(NO\textsubscript{3})\textsubscript{4}(H\textsubscript{2}O)\textsubscript{2}]} \\
\text{Na\textsubscript{3}[CrBr\textsubscript{6}]} \\
\text{[PdI(N\textsubscript{3})(NH\textsubscript{3})\textsubscript{2}]} \\
\]
2. (10 points) Which ligand is more likely to coordinate to a metal cation: ethylenediamine or ammine? Briefly explain why.

3. (12 points) The metal complexes $[\text{CoBr}_6]^3^–$ and $[\text{Co(CN)}_6]^3^–$ display different magnetic properties: one is paramagnetic and one is diamagnetic. Which is which? Explain why. (The respective energy-level diagrams may be useful.)
4. (12 points) Briefly explain the distinguishing characteristics of these three types of isomerism: 1) cis- and trans-, 2) fac- and mer-, and 3) optical.

5. (12 points) Should the metal complex [Cr(CN)₆]⁴⁻ have an ideal or distorted octahedral geometry? Use an energy-level diagram to explain your reasoning.
6. (8 points) How many unpaired electrons will be in the tetrahedral metal complex \([\text{NiCl}_4]^-\)? Explain your choice with an energy-level diagram.

7. (4 points) Prussian blue is a pigment used for absorbing radioactive isotopes; it is commonly called ferric hexacyanoferrate(II). What is its chemical formula?

8. (12 points) Sodium chloride is an insulator with an absorption edge of 146 nm; calculate the corresponding bandgap in eV.

9. (12 points) Calculate the ligand-field stabilization energy (LFSE) in terms of \(\Delta_0\) and \(P\) for an octahedral \(\text{Ni}^{3+}\) metal complex in its low-spin state.