Comprehensive Inorganic Chemistry

Name: Date:

Answer the following questions related to advanced topics in inorganic chemistry. Show your work for calculation-based questions where applicable.

1. Determine the oxidation state of chromium in the compound $K_2Cr_2O_7$.

2. Draw the molecular orbital diagram for diatomic nitrogen (N_2). What is its bond order? Is the molecule paramagnetic or diamagnetic?

3. For the complex $[Co(NH_3)_5Cl]^{2}$, determine the following:
   a) The coordination number of the central metal ion.
   b) The geometry of the complex.
   c) The oxidation state of cobalt in this complex.

4. Using the spectrochemical series, explain why $[CoF_6]^{3}$ is high-spin, while $[Co(NH_3)_6]^{3}$ is low-spin.

5. Explain why the melting points of alkali metals decrease as you go down the group from lithium to cesium.