MATRL 218/CHEM277: Assignment 5

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1. The one dimensional chain compound $K_2PtBr_4$ has square planes of $PtBr_4^{2-}$ forming chains that are linked through Pt–Pt bonds. Describe the crystal field splitting, and sketch schematic density of states. What does the dispersion along the Pt–Pt bonds look like and which orbital is involved? Is $K_2PtBr_4$ a metal? How can it be made into a metal.

2. $FeS_2$ (fools gold) has the pyrite structure (octahedral Fe) and because of a bond between the two S atoms (characterized by a short S–S distance), it can be formulated $Fe^{2+}[S_2]^{2-}$. Magnetic measurements suggest that the compound is non-magnetic.
   
   (a) Sketch out the crystal field (showing $t_{2g}$ and $e_g$ levels) and fill them with the correct number of electrons.
   
   (b) Sketch out schematic densities of states showing Fe $d$ states and S $p$ states. Do you expect a metal or an insulator?
   
   (c) What do you expect the situation in $CoS_2$ to be? It has the same crystal structure.

3. What does the concept of the divergence of susceptibility mean to you. When does the susceptibility diverge for a Curie paramagnet. Explain what happens when (i) ferromagnetic interactions are present, and (ii) antiferromagnetic interactions are present, using the concept of an internal field. Make sketches for all cases.

4. Sketch the magnetic densities of state for antiferromagnetic $LaCrO_3$ (perovskite), and ferromagnetic $CrO_2$ (rutile).

5. Consider various normal spinel ferrites $A^{2+}Fe^{3+}_2O_4$. For the A ions Mn, Co, or Ni, calculate the numbers of unpaired electrons per spinel formula unit if the spinels are all ferrimagnetic (the moments on the A atom and Fe point in opposite direction's).