Answer the following questions as you read the following paper (*Chem. Commun.,* 2018, 54, 12045-12048) regarding the synthesis and characterization of a unique paramagnetic square planar Co(III) complex.  Note: this is a very challenging paper containing many experimental techniques specific to this particular area of inorganic chemistry. Even non-expert, PhD-level chemists will not be familiar with all the methods and data presented in this paper.  This guided reading and discussion will focus on using your knowledge of fundamental inorganic chemistry to understand the major conclusions of the article and why they are interesting.

Before reading the paper answer these review questions.

1. An example of a typical Co(III) complex is [Co(H2O)6]3+.  Draw a splitting diagram for this complex and calculate the spin only magnetic moment (, where n is the number of unpaired electrons).
2. Are square planar complexes typically high or low spin?

Now read the paper quickly making a list of concepts you are unfamiliar with but keep moving on through the paper.  After you have finished begin to answer the questions below referring back to the schemes and text the question asks about.   Note: For the following questions, specific figures and acronyms are mentioned. Often, authors will include a reference to a specific figure in the text when they are drawing conclusions from the data, and so it can be useful to find those specific sentences in the text of the paper when you are analyzing their data and conclusions.

1. Research is inherently collaborative; look at the authors of this paper and their affiliations.
   1. How many authors contributed to this paper?
   2. How many different laboratories or institutions collaborated on this paper?
   3. Who is the principle investigator and at which institution are they affiliated?
2. Now, consider Scheme 1.
   1. Indicate the geometries and electron counts of the species **1**, **2**, and **3** in this scheme.
   2. What type of reaction is occuring from **1** to **2**? How did this reaction differ when the reaction was performed aerobically in CH3CN compared to using AgPF6 in THF/CH3CN?
   3. What is occurring mechanistically during the conversion of **2** to **3** and why might the geometry change occur?
3. ORTEP diagram, X-ray crystallography (Figure 1).
   1. The authors show ORTEP diagrams in Figure 1. Which compounds in the paper

correspond to the crystal structures in Figure 1?

* 1. What are the Co-O bond lengths in **1** and **2**?
  2. What do the Co-O bond lengths indicate about the oxidation states of **1** and **2**?

1. UV-Vis (Figure 2)
   1. Figure 2 shows a UV-Vis spectrum of a reaction over time. What happens to the absorbance at 405 nm after H2O2 is added?
   2. What product is observed at the end of the reaction, based on its UV-Vis spectrum?
   3. What is the significance of the lack of change in the spectrum in coordinating and non-coordinating solvents?
   4. Read the paragraph starting with “Addition of O2…” on the bottom of page 12046. What is the key message the authors are communicating in this paragraph?
2. SQUID (Figure 3) and FIRMS (Figure 4)
   1. What do SQUID and FIRMS stand for?
   2. What do SQUID, EPR, and FIRMS look for?
   3. What was the magnetic moment from the SQUID data?
   4. How did the authors confirm the SQUID results?
3. Theoretical investigation of compound 2 (Scheme 2).
   1. How many unpaired electrons are shown in the calculated d-orbital splitting diagram in Scheme 2?
   2. Would you expect a Co(III) d6 square planar complex to be high or low spin? The d-orbital splitting diagram shown in Scheme 2 is calculated for the square planar complex shown in the scheme. How does this diagram compare to square planar d-orbital splitting diagrams you have seen in the past? (It may be helpful to you to refer to your answer to question B in the pre-reading section).
   3. The ligands shown on the cobalt complex have electron-withdrawing groups. How do the pKa’s (given on page 12045 in the first paragraph of the paper) of the conjugate acid of the ligand relate to its electron-withdrawing ability? (Note: for comparison the pKa of *t*-butyl alcohol is 19.2). How might the difference between pinF and pin help to explain the splitting diagram in Scheme 2?

7. Based on Scheme 2, why do you think this paper was interesting enough to be published? (Hint, what is the key unusual feature of this complex?)