It's in Your Blood!

Elementary Problem 4 - 10 points

Deadline: 8:30 PM IST, 27^{th} August

Bio-Inorganic Chemistry deals not only with the naturally available bio-inorganic systems but also with bio-mimetic systems. Let's now try to explore the chemistry of biomimetic systems and see if we can rationalise the electronic structure, structure and reactivity of bio-mimetic systems through the following question.

One of the most widely studied bio-mimetic systems is Fe(TPP)(2-MeIm). TPP is tetraphenyl porphyrin, and 2-MeIm is 2-methyl imidazole. Suppose you have been provided with Fe(TPP)(2-MeIm):

1. Imagine you are a research student at the lab of some bio-inorganic chemist. You have somehow managed to prepare O_2^{2+}:

   a) What do you expect the persistence of O_2^{2+} to be?

   b) Suppose you are now studying the structure of the complex of O_2^{2+} with Fe(TPP)(2-MeIm). What do you expect the binding mode (linear, perpendicular, bent, or any other mode you can think of) of O_2^{2+} with Fe(TPP)(2-MeIm) to be? Justify your answer.

2. You have been given a sample of iron protoporphyrin-IX complex. Can this complex serve as an oxygen carrier? Why/Why not?

3. Suppose you have somehow managed to substitute the Fe^{2+} ion in the complex with Co^{2+}. Can this cobalt-protoporphyrin IX complex act as an effective oxygen carrier? Justify. Also, what can be the possible mode of binding of NO with the cobalt-protoporphyrin complex?