**Introduction to Borylene Ligands**

Please complete these guiding questions to the journal article *Chem. Soc. Rev.,* **2013**, *42*, 3197-3208. DOI: [10.1039/c3cs35510a](file:///C:\Users\anthony\Downloads\10.1039\c3cs35510a)

This literature discussion celebrates Dr. Holger Braunschweig for being the recipient of the M. Frederick Hawthorne Award in Main Group Inorganic Chemistry 2024 from the American Chemical Society. The award citation reads: “*For groundbreaking discoveries in the chemistry of hypocoordinate and hypovalent boron compounds.*”

[insert Figure 1 from the article here]

1) The award citation refers to “hypovalent boron compounds.” What does the term “hypovalent” mean? How does this term apply to boron specifically?

2) Figure 1 compares the energies of the molecular orbitals of borylene B-F to other isoelectronic diatomic compounds (N2, CO) that can serve as ligands to transition metals.

a) Briefly explain why N2, CO, and BF are isoelectronic.

b) Draw the Lewis structures of N2, CO, and BF. Note that there are multiple Lewis structures that can be drawn for BF; draw the Lewis structure that minimizes formal charge on the atoms.

c) In the text of the article, the authors refer to Figure 1 to identify the sigma orbital or each diatomic as the HOMO and the pi orbitals as the LUMO for each of the three compounds. Define the acronyms HOMO and LUMO.

d) The s molecular orbital for N2 is labeled sg but the s molecular orbitals for CO and BF do not have this label. What does the “g” mean and why does the label apply only to N2?

e) According to Valence Bond Theory, what type of orbital does the lone pair in the sigma orbital of each diatomic reside in?

3) a) According to Figure 1, what happens to the energy of the sigma orbital for the diatomic moving from N2 to CO to BF? What happens to the energy of the pi orbitals?

b) In the article, the authors state that, in the context of coordination to a metal center, BF is a better sigma donor than CO which is a better sigma donor than N2. Infer the relationship between the energy of the sigma orbital and the ability to be a sigma donor.