

Chem 155 Homework #9 Due at the start of class on **FRIDAY MARCH 9**

Reading: Chapter 16, begin Chapter 17

Chapter 16 Problems:

16.5

16.8

16.10

16.12

16.16

16.17

16.27

16.33

Chapter 17 Problems:

17.1

17.15

17.22

Additional Problems:

1) Discuss the experimental evidence supporting the existence of molecular orbitals. Explain how a chemist might measure the energy of an electron in a particular molecular orbital.

2) When we breath in air, O₂ is taken up in the blood by the protein hemoglobin, which contains Fe²⁺ ions bound to a heme group [(heme)Fe²⁺]. The iron-heme reversibly binds O₂, picking it up and releasing it in the other tissues (see Oxtoby, pp. 284-286). In the bound form (oxygenated heme), one electron is transferred from the iron to the O₂ so that this species can be described as [(heme)Fe³⁺(O₂⁻)]. Is the oxygen-oxygen bond length in heme longer or shorter than the bond in O₂. Explain.

3) Find a paper with a molecular orbital measurement that shows an experimental measurement of a molecular wavefunction (e.g. via STM, angle resolved UPS, or otherwise). Include a printout on your homework and the citation.

4) **Extra credit** (8 points—all parts must be completed for credit): As noted in Chapter 17, the greenhouse effect caused by the IR absorption of CO₂ has important implications for our use of fossil fuel. Using the DOE data available at <http://www.eia.doe.gov/emeu/aer/overview.html>

a) determine what fraction of our energy supply current comes from fossil fuels

b) calculate what the average power consumption (in TW) was for the entire US during 2008

c) pick a favorite alternative power source: wave power, wind power, solar power, nuclear power, biofuels. Calculate how much land area (or number of km of wave power stations, or number of new nuclear power stations) that would be needed to generate (on average) 1 TW of non-fossil power. Print out a map of the US from Wikipedia and draw your area devoted to renewables to scale. You can find conversion efficiencies, density values etc. online. A great resource is the

free book by David MacKay (chief advisor to the UK government on climate and energy)
<http://www.withouthotair.com/>.