

Chem 155 Homework #9 Due at the start of class on Mon. March 10

Reading: Finish Chapter 16, begin Chapter 17 (note—you should try to read ALL of chapter 17 before the last day of lecture on March 16).

Chapter 15 Problems: DeBroglie turned over in his grave after the midterm!
15.31

Chapter 16 Problems:

16.5

16.8

16.10

16.12

16.16

16.17

16.18

16.22

16.28

16.39

Chapter 17 Problems:

17.1

17.2

17.13

17.15

Additional Problems:

1) When we breath in air, O_2 is taken up in the blood by the protein hemoglobin, which contains Fe^{2+} ions bound to a heme group [(heme) Fe^{2+}]. The iron-heme reversibly binds O_2 , 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 O_2 so that this species can be described as [(heme) $Fe^{3+}(O_2^-)$]. Is the oxygen-oxygen bond length in heme longer or shorter than the bond in O_2 . Explain.

2) A quantum cascade laser is a laser that emits light when electrons make transitions between levels in artificial quantum wells grown in a semiconductor chip. Treat the energies as a 1D 'particle-in-an-infinite-box' problem and assume the laser action occurs between the $n=3$ and $n=2$ levels in wells that are 2.5 nm wide. What wavelength of light is emitted? What part of the spectral region is this? Suggest how a chemist might use such a laser to make a measurement.

3) 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.