University of Windsor
Chemistry and Biochemistry
Chemistry 59-250, Fall Term 2005

Assignment 5

Question #1
Born-Haber Cycle

Use Born-Haber cycles calculations to show why formation of the salt $MgBr_2$ is favoured over MgBr. Information you need (all in kJ/mol) to estimate the enthalpies of formation for the two salts:

$Mg_{(s)} \rightarrow Mg_{(g)}$ $\Delta H^\circ_{vap} = 147$ $Br_{2\,(l)} \rightarrow Br_{2\,(g)}$ $\Delta H^\circ_{vap} = 31$

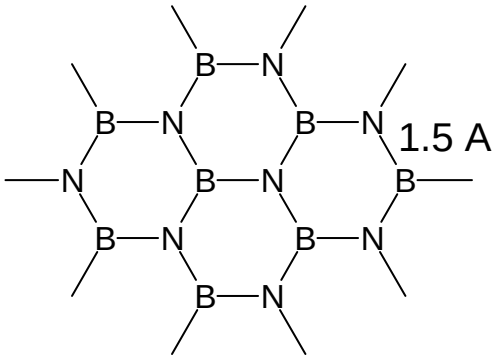
$Br_{2\,(g)} \rightarrow 2\,Br_{(g)}$ $\Delta H^\circ_{d} = 193$ $Br_{(g)} + e^- \rightarrow Br^-_{(g)}$ $\Delta H^\circ_{ea} = -331$

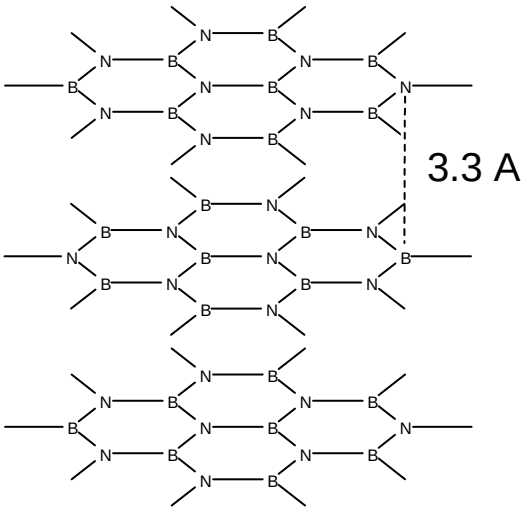
$Mg_{(g)} \rightarrow Mg^+_{(g)}$ $\Delta H^\circ_{ie} = 737$ $Mg^+_{(g)} \rightarrow Mg^{+2}_{(g)}$ $\Delta H^\circ_{ie} = 1450$

Use the Born-Mayer equation to estimate the lattice energies for each of the salts: the radius in Å for Mg is 1.60, the radius for Mg^+ is 1.16, the radius for Mg^{+2} is 0.72 and the radius for Br^- is 1.96. Assume that MgBr has a Rock Salt structure and that $MgBr_2$ has a Fluorite structure.

Question #2
Madelung Constants

One form of boron nitride (BN) has a hexagonal layer structure similar to that of graphite. Assuming an ionic structure as pictured below answer the following questions:





a) what is the energy of attraction between a pair of adjacent B^{+3} and N^{-3} ions?
b) what are the **first three** terms in the expression for the Madelung constant for this arrangement?
c) how would the terms change in part b) if the adjacent layer had a boron-nitrogen distances of 2.7 Å instead of 3.3 Å?