Problem set 5

1. Determine the enthalpies of formation for WCl, WCl_3 and WCl_6 using a Born-Haber cycle, calculating lattice energies using the Kapuskinskii equation.

(i)   WCl does not exist. What particularly large factor is mitigating against its formation?

(ii) WCl_3 and WCl_6 do exist. Find out their actual structures, and describe them. Do either of these fit the description of a "simple ionic solid"?

(iii)   What do the Born-Haber cycle and Kapuskinskii equation fail to take into account?

IE_n(W) 770, 1700, 2300, 3400, 4600, 5900 kJ mol^{-1}; ΔH_a(W) 860 kJ mol^{-1}; $\Delta H_a(Cl_2)$ 244 kJ mol^{-1}; EA(Cl) 349 kJ mol^{-1}; r_+ 130 pm, r_{3+} 98 pm, r_{6+} 74 pm, r_- 167 pm.

2. Calculate the enthalpy of formation of LnF_2, LnF_3 and LnF_4 (Ln = pick a lanthanide element) using a Born-Haber cycle. Use the Kapuskinskii equation to calculate the lattice enthalpy. Get the data you need from *WebElements* (http://www.webelements.com/) or *Visual Elements* (http://www.chemsoc.org/viselements/).

WebElements lists all fluorides that are actually known for your element. Comment upon the existence or non-existence of LnF_2 and LnF_4 for your particular lanthanide in light of your calculated enthalpies of formation. If your element does not have known LnF_2 or LnF_4 compounds, name a lanthanide element that does and explain why.