Problems of Thermochemistry: Born–Haber cycle

1) Calculate the lattice energy of $NaCl_{(s)}$ using a Born–Haber cycle.

Data: Enthalpy of sublimation of $Na_{(s)}$ = 107.5 kJ/mol
1st ionization energy of $Na_{(g)}$ = 496 kJ/mol
Bond dissociation energy of $Cl_{2(g)}$ = 242.58 kJ/mol
1st electron affinity of $Cl_{(g)}$ = −348.57 kJ/mol
Standard enthalpy of formation of $NaCl_{(s)}$ = −411.2 kJ/mol

2) Determine the standard enthalpy of formation of $SrI_{2(s)}$ using a Born–Haber cycle.

Data: Enthalpy of sublimation of $Sr_{(s)}$ = 164 kJ/mol
1st ionization energy of $Sr_{(g)}$ = 549 kJ/mol
2nd ionization energy of $Sr_{(g)}$ = 1064 kJ/mol
Enthalpy of sublimation of $I_{2(s)}$ = 62.4 kJ/mol
Bond dissociation energy of $I_{2(g)}$ = 152.55 kJ/mol
1st electron affinity of $I_{(g)}$ = −295.15 kJ/mol
Lattice energy of $SrI_{2(s)}$ = −1959.75 kJ/mol

3) Calculate the lattice energy of $CuBr_{(s)}$ using a Born–Haber cycle.

Data: Enthalpy of sublimation of $Cu_{(s)}$ = 337.7 kJ/mol
1st ionization energy of $Cu_{(g)}$ = 745 kJ/mol
Enthalpy of vaporization of $Br_{2(l)}$ = 29.96 kJ/mol
Bond dissociation energy of $Br_{2(g)}$ = 193.87 kJ/mol
1st electron affinity of $Br_{(g)}$ = −324.54 kJ/mol
Standard enthalpy of formation of $CuBr_{(s)}$ = −104.6 kJ/mol

4) Find out the lattice energy of $SnCl_{2(s)}$ using a Born–Haber cycle.

Data: Enthalpy of fusion of $Sn_{(s)}$ = 7.03 kJ/mol
Enthalpy of vaporization of $Sn_{(l)}$ = 296.1 kJ/mol
1st ionization energy of $Sn_{(g)}$ = 709 kJ/mol
2nd ionization energy of $Sn_{(g)}$ = 1412 kJ/mol
Bond dissociation energy of $Cl_{2(g)}$ = 242.58 kJ/mol
1st electron affinity of $Cl_{(g)}$ = −348.57 kJ/mol
Standard enthalpy of formation of $SnCl_{2(s)}$ = −325.1 kJ/mol

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5) Calculate the lattice energy of $NiF_{2(s)}$ using a Born–Haber cycle.

Data: Enthalpy of fusion of $Ni_{(s)}$ = 17.48 kJ/mol
Enthalpy of vaporization of $Ni_{(l)}$ = 377.5 kJ/mol
1st ionization energy of $Ni_{(g)}$ = 737 kJ/mol
2nd ionization energy of $Ni_{(g)}$ = 1753 kJ/mol
Bond dissociation energy of $F_{2(g)}$ = 156.9 kJ/mol
1st electron affinity of $F_{(g)}$ = −328.16 kJ/mol
Standard enthalpy of formation of $NiF_{2(s)}$ = −651.5 kJ/mol

6) Determine the lattice energy of $PbF_{2(s)}$ using a Born–Haber cycle.

Data: Enthalpy of sublimation of $Pb_{(s)}$ = 195.2 kJ/mol
1st ionization energy of $Pb_{(g)}$ = 716 kJ/mol
2nd ionization energy of $Pb_{(g)}$ = 1450 kJ/mol
Bond dissociation energy of $F_{2(g)}$ = 156.9 kJ/mol
1st electron affinity of $F_{(g)}$ = −328.16 kJ/mol
Standard enthalpy of formation of $PbF_{2(s)}$ = −664 kJ/mol

Answers:

1) −787.42 kJ/mol
2) −558.1 kJ/mol
3) −974.675 kJ/mol
4) −2294.67 kJ/mol
5) −3037.06 kJ/mol
6) −2525.78 kJ/mol