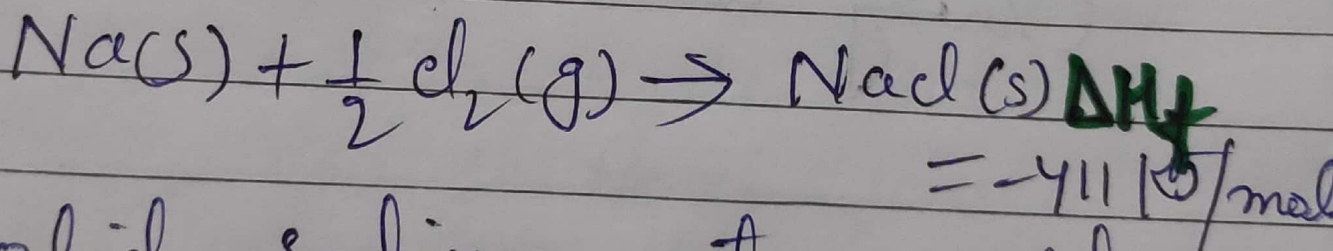
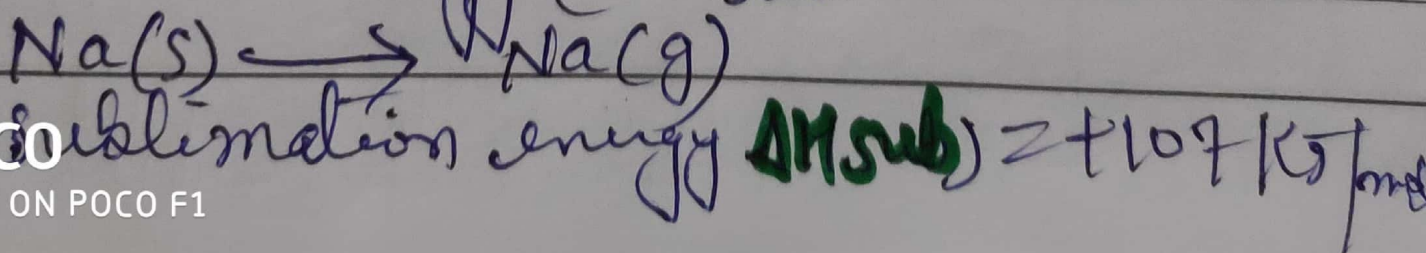


Born Haber Cycle

Born haber cycle is a cycle of enthalpy change of process that leads to the formation of a solid crystalline ionic compound from the elemental atoms in their standard state and of the enthalpy of formation of solid compound. As for example born haber cycle can be understand by formation of NaCl solid from its elements.



1. Solid sodium atom subliming to gaseous atom by absorbing heat energy (ΔH_{sub}).



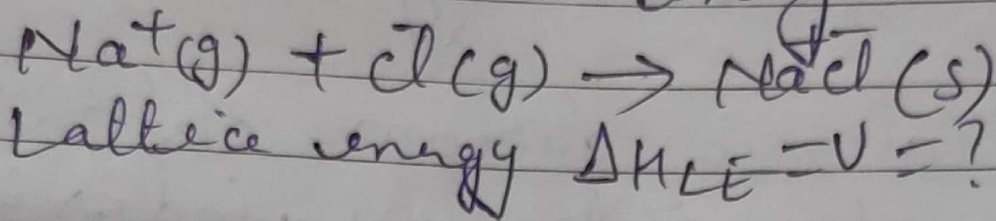
2) Gaseous sodium atom DATE absorbs the ionization energy to release one electron and forms gaseous sodium ion
 $\text{Na}(g) \rightarrow \text{Na}^+(g) + e^-$
Ionization energy $\Delta H_{IE} = +502 \text{ kJ/mol}$

3) Diatomic gaseous chlorine breaks into two individual atoms by absorbing bond energy. Each chlorine atom absorbs half of the bond energy of chlorine molecule.
 $\text{Cl}_2(g) \rightarrow \frac{1}{2} 2\text{Cl}(g) \frac{1}{2}$

Bond dissociation energy of chlorine $\Delta H_{diss} = \frac{1}{2} \times 242 = +121 \text{ kJ/mol}$

4) Chlorine atom accepts an electron to form chloride ion and release energy equivalent to electron affinity.
Electron affinity $\Delta H_{EA} = -355 \text{ kJ/mol}$

5) Gaseous sodium ion and gaseous chloride ion combine to form solid sodium chloride molecule and release energy equivalent to lattice energy.



Summation of enthalpy of all the processes (From Hess law) give the net enthalpy of formation of solid crystalline NaCl. This should be equal to the experimentally measured enthalpy of formation of solid sodium chloride.

$$\Delta H_f^\circ = \Delta H_{\text{sub}} + \Delta H_{\text{IE}} + \frac{1}{2} \Delta H_{\text{dis}} + \Delta H_{\text{EA}}$$

$$\text{or, } U \text{ or } \Delta H_f^\circ - (\Delta H_{\text{sub}} + \Delta H_{\text{IE}} + \frac{1}{2} \Delta H_{\text{dis}} + \Delta H_{\text{EA}} + U) = 0$$

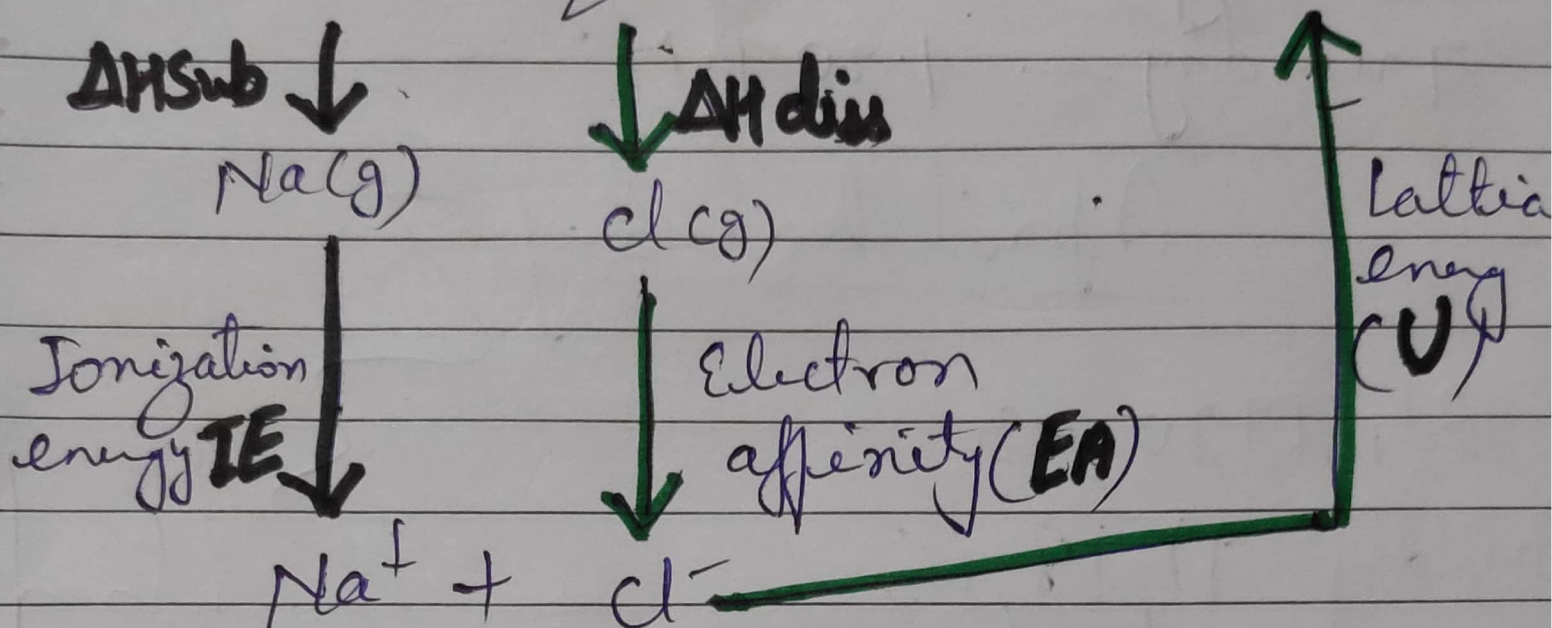
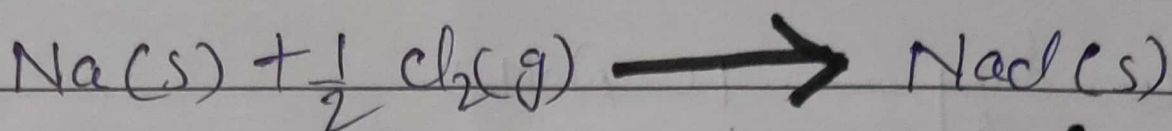
Lattice energy of NaCl solid

$$U = \Delta H_f^\circ - (\Delta H_{\text{sub}} + \Delta H_{\text{IE}} + \frac{1}{2} \Delta H_{\text{dis}} + \Delta H_{\text{EA}})$$

$$= -411 - 109 - 502 - 121 + 355 = -786 \text{ kJ/mol}$$



DATE _____



Born Haber cycle for NaCl.