LATTICE ENERGY, $\Delta H^{o}_{lattice}$

Problem-solving Example 1

Calculate the electron-affinity of bromin atom from the following data: (using Born-Haber cycle)

ΔH_f° of $KBr(s)$ $= -392\ kJmol^{-1}$

ΔH°_{atom} $= +90\ kJmol^{-1}$

ΔH°_{diss} @ BE of Br_2 $= +190\ kJmol^{-1}$

$\Delta H^\circ_{vaporisation}$ of $Br_2(\ell)$ $= 31\ kJmol^{-1}$

ΔH_{IE_1} of $K(g)$ $= 418\ kJmol^{-1}$

Lattice Energy, $\Delta H_{lattice}$ $= +688\ kJmol^{-1}$

SOLUTION

Solution:

(i) $K(s) + Br_2(l) \longrightarrow KBr(s)$; $\Delta H_f^\circ = -392\ kJmol^{-1}$

(ii) $K(s) \longrightarrow K(g)$; $\Delta H_{atom}^\circ = +90\ kJmol^{-1}$

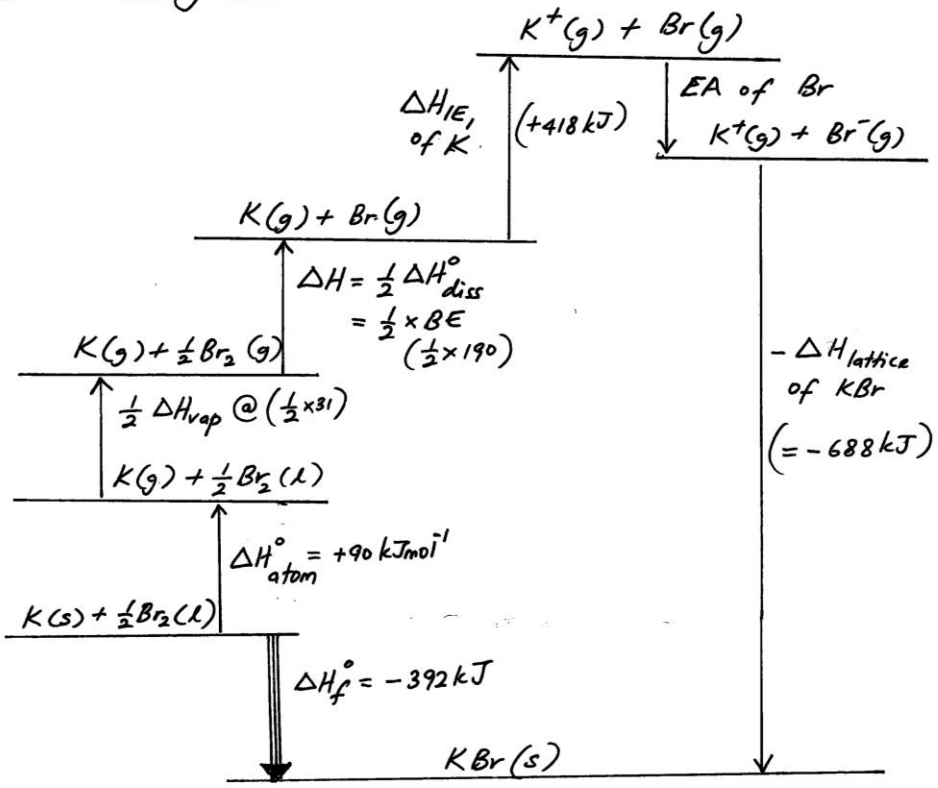
(iii) $Br_2(g) \longrightarrow 2Br(g)$; $\Delta H_{diss}^\circ = BE = +190\ kJmol^{-1}$

(iv) $Br_2(l) \longrightarrow Br_2(g)$; $\Delta H_{vap}^\circ = 31\ kJmol^{-1}$

(v) $K(g) \longrightarrow K^+(g) + e^-$; $\Delta H_{IE_1} = 418\ kJmol^{-1}$

(vi) $KBr(s) \longrightarrow K^+(g) + Br^-(g)$; $\Delta H_{lattice} = +688\ kJmol^{-1}$

Born Haber Cycle:



Using Hess's Law:

$$\Delta H_f^\circ = \Delta H_{atom}^\circ + \tfrac{1}{2}\Delta H_{vap}^\circ + \tfrac{1}{2}\Delta H_{diss}^\circ + \Delta H_{IE_1} + EA + (-\Delta H_{lattice})$$

$$-392 = +90 + \left(\tfrac{1}{2}\times 31\right) + \left(\tfrac{1}{2}\times 190\right) + (418) + EA + (-688)$$

$$\therefore EA = -322.5\ kJmol^{-1}\ (Ans)$$

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