

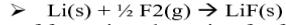
Chem 210 Spring 06 Lattice Energy Worksheet

Definition: Lattice Energy: Energy given off when gaseous ions turn into the solid salt.

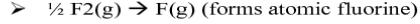
Example: $\text{Li}^+(\text{g}) + \text{F}^-(\text{g}) \rightarrow \text{LiF}(\text{s})$

Reminders:

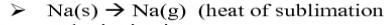
Heat of formation: Energy to go from the standard state elements to the desired product:



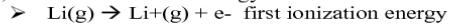
Note: The heat of formation also exists for formation of "not standard state" products



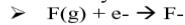
Also, we have heat of fusion, sublimation and vaporization



We have first, second...ionization energy



We have electron affinity



$\text{Li}(\text{g}) \rightarrow \text{Li}^+(\text{g}) \quad \Delta E_1 = 520 \text{ kJ}$ 1st ionization E

$\text{F}(\text{g}) + \text{e}^- \rightarrow \text{F}^-(\text{g}) \quad \Delta E_A = -328 \text{ kJ}$ Electron aff

Add them up $\text{Li}(\text{g}) + \text{F}(\text{g}) \rightarrow \text{Li}^+(\text{g}) + \text{F}^-(\text{g}) \Delta E_1 + \Delta E_A = 192 \text{ kJ}$

Notice that the standard heat of formation of solid $\text{Li}(\text{s}) + \frac{1}{2} \text{F}_2(\text{g}) \rightarrow \text{LiF} = -617 \text{ kJ/mole}$

Where is the very energetic reaction?



1. Calculate the lattice energy, $\Delta E_{\text{lattice}}$, of $\text{NaBr}(\text{s})$,

$\text{Br}^-(\text{g}) \rightarrow \text{Br}(\text{g}) + \text{e}^-$	$+325$
$\text{Br}(\text{g}) \rightarrow 1/2 \text{Br}_2(\text{g})$	-112
$\text{Na}^+(\text{g}) + \text{e}^- \rightarrow \text{Na}(\text{g})$	-496
$\text{Na}(\text{g}) \rightarrow \text{Na}(\text{s})$	-107
$\text{Na}(\text{s}) + 1/2 \text{Br}_2(\text{g}) \rightarrow \text{NaBr}(\text{s})$	-361
$\text{Na}^+(\text{g}) + \text{Br}^-(\text{g}) \rightarrow \text{NaBr}(\text{s})$	$\Delta E_{\text{lattice}} = ? -751 \text{ kJ}$

given the following thermochemical equations.

$\text{Na}(\text{s}) \rightarrow \text{Na}(\text{g})$	$\Delta H_f^\circ = 107 \text{ kJ}$
$\text{Na}(\text{g}) \rightarrow \text{Na}^+(\text{g}) + \text{e}^-$	$\Delta IE = 496 \text{ kJ}$
$1/2 \text{Br}_2(\text{g}) \rightarrow \text{Br}(\text{g})$	$\Delta H_f^\circ = 112 \text{ kJ}$
$\text{Br}(\text{g}) + \text{e}^- \rightarrow \text{Br}^-(\text{g})$	$\Delta EA = -325 \text{ kJ}$
$\text{Na}(\text{s}) + 1/2 \text{Br}_2(\text{g}) \rightarrow \text{NaBr}(\text{s})$	$\Delta H = -361 \text{ kJ}$
a. -751 kJ	b. -455 kJ
c. -290 kJ	d. $+290 \text{ kJ}$
e. $+1403 \text{ kJ}$	

2. Use the following equations to calculate the lattice energy for: NaCl , $\text{Na}^+(\text{g}) + \text{Cl}^-(\text{g}) \rightarrow \text{NaCl}(\text{s}) \quad \Delta H = ?$

$\text{Na}(\text{s}) \rightarrow \text{Na}(\text{g})$	$\Delta H = 109 \text{ kJ};$
$\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g})$	$\Delta H = 243 \text{ kJ};$
$\text{Na}(\text{g}) \rightarrow \text{Na}^+(\text{g}) + \text{e}^-$	$\Delta H = 496 \text{ kJ};$
$\text{Cl}(\text{g}) + \text{e}^- \rightarrow \text{Cl}^-(\text{g})$	$\Delta H = -349 \text{ kJ};$
$\text{Na}(\text{s}) + 1/2 \text{Cl}_2(\text{g}) \rightarrow \text{NaCl}(\text{s})$	$\Delta H = -411 \text{ kJ}$
$\text{Cl}^-(\text{g}) \rightarrow \text{Cl}(\text{g}) + \text{e}^-$	$+349$
$\text{Cl}(\text{g}) \rightarrow \frac{1}{2} \text{Cl}_2(\text{g})$	$-243/2$
$\text{Na}^+(\text{g}) + \text{e}^- \rightarrow \text{Na}(\text{g})$	-496
$\text{Na}(\text{g}) \rightarrow \text{Na}(\text{s})$	-109
$\text{Na}(\text{s}) + 1/2 \text{Cl}_2(\text{g}) \rightarrow \text{NaCl}(\text{s})$	$\Delta H = -411 \text{ kJ}$
$\text{Na}^+(\text{g}) + \text{Cl}^-(\text{g}) \rightarrow \text{NaCl}(\text{s})$	$\Delta H = ? -789 \text{ kJ}$