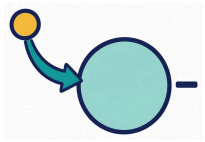
Lattice Enthalpy Map

OCR A Level Chemistry A · 5.2.1 Lattice enthalpy

1 Atomisation and EA

5.2.1(b)

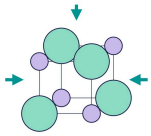
- $\Delta_{at}H$: **1 mol of gaseous atoms**
- $\frac{1}{2}Cl_2(g) \rightarrow Cl(g)$: ½ × bond enthalpy
- **EA_1**: $X(g) + e^- \rightarrow X^-(g)$, exothermic
- **EA_2** endothermic: repelled by X^-



2 Lattice enthalpy, $\Delta_{LE}H$

5.2.1(a)

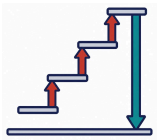
- **Gaseous ions → 1 mol of ionic lattice**
- **Exothermic**: ions attract
- More exothermic: **stronger ionic bonding**
- Not measurable directly

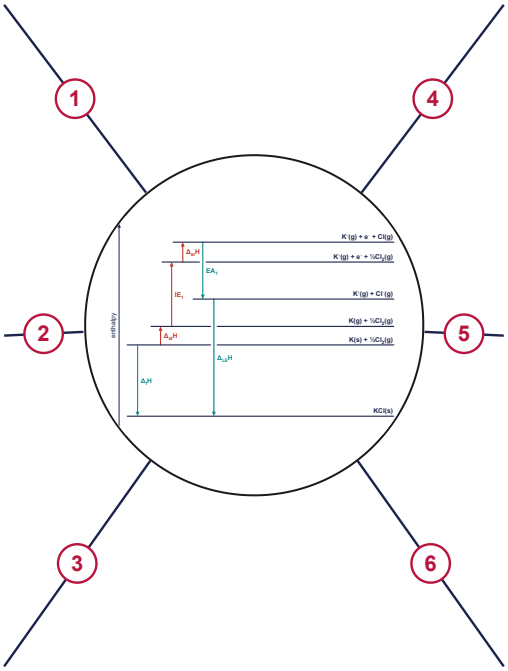


3 Born–Haber cycles

5.2.1(b)

- Up: atomise, ionise; down: EA, $\Delta_{LE}H$
- **$\Delta_{LE}H = \Delta fH -$ (other steps)**
- Hess: both routes have the **same total**
- **Keep every sign**

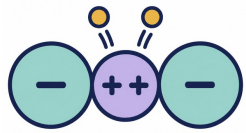




4 2+ ions, missing values

5.2.1(b)

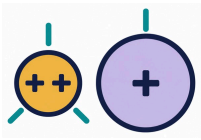
- 2+ ions: **IE_1 + IE_2**; double for two ions
- Oxides: **EA_1 (−) and EA_2 (+)**
- Missing value: the **same cycle, rearranged**
- e.g. EA_2 or ΔatH from a known $\Delta_{LE}H$



5 Charge and radius

5.2.1(e)

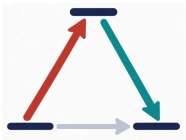
- **Smaller** ions: more exothermic
- **Higher charge**: much more exothermic
- Both $\Delta_{LE}H$ and $\Delta_{hyd}H$
- $\Delta_{sol}H$ changes far less



6 Solution and hydration

5.2.1(c), (d)

- $\Delta_{hyd}H$: 1 mol of gaseous ions → aq
- **$\Delta_{sol}H = -\Delta_{LE}H + \Sigma\Delta_{hyd}H$**
- Count **every** ion
- Level diagram: gaseous ions at the top



The steps of a Born–Haber cycle

sodium fluoride; values in kJ mol⁻¹

Step	Equation	Value	Direction
$\Delta atH(Na)$	$Na(s) \rightarrow Na(g)$	+107	up
$IE_1(Na)$	$Na(g) \rightarrow Na^+(g) + e^-$	+496	up
$\Delta atH(F)$	$\frac{1}{2}F_2(g) \rightarrow F(g)$	+79	up
$EA_1(F)$	$F(g) + e^- \rightarrow F^-(g)$	−328	down
$\Delta_{LE}H$	$Na^+(g) + F^-(g) \rightarrow NaF(s)$	−928	down
ΔfH	$Na(s) + \frac{1}{2}F_2(g) \rightarrow NaF(s)$	−574	down

Worked examples

$\Delta_{LE}H$ of NaF

- sum = 107 + 496 + 79 − 328
- = +354 kJ mol⁻¹
- $\Delta_{LE}H$ = −574 − 354 = **−928**

A missing value

- LiCl: $\Delta_{LE}H$ −861, ΔfH −409
- $\Delta atH(Cl)$ = −409 + 861 − 159 − 520 + 349
- = **+122 kJ mol⁻¹**

$\Delta_{sol}H$ of KBr

- $-\Delta_{LE}H$ = +679
- $\Sigma\Delta_{hyd}H$ = −322 − 335 = −657
- $\Delta_{sol}H$ = **+22 kJ mol⁻¹**

Entropy and ΔG decide whether a change is feasible (5.2.2).

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