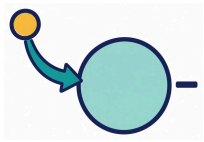
Lattice Energy Map

Cambridge International AS & A Level Chemistry · Topic 23 Lattice energy

1 Atomisation and EA

23.1.1, 23.1.2

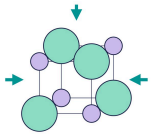
- ΔH_{at}: **1 mol of gaseous atoms**
- $\frac{1}{2}Cl_2(g) \rightarrow Cl(g)$: ½ × bond energy
- **EA_1**: $X(g) + e^- \rightarrow X^-(g)$, exothermic
- **EA_2** endothermic: repelled by X^-



2 Lattice energy, ΔH_{latt}

23.1.1

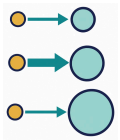
- **Gaseous ions → 1 mol of solid**
- **Exothermic**: ions attract
- Not ΔH_f: that starts from elements
- Not measurable directly

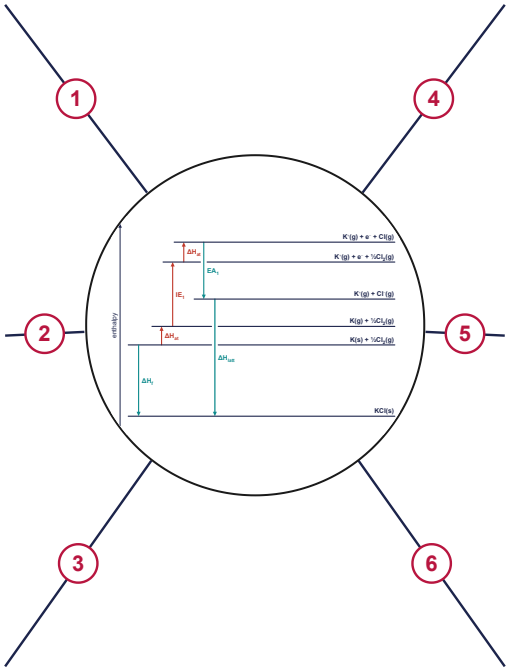


3 Electron affinity trends

23.1.2

- Factors: **nuclear charge**, radius, shielding
- Down Groups 16, 17: **less exothermic**
- Larger, more shielded: weaker pull
- O and F: **crowded n = 2 shell**

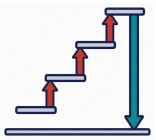




4 Born–Haber cycles

23.1.3

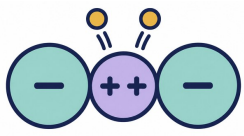
- Up: atomise, ionise; down: EA, ΔH_{latt}
- **$\Delta H_{latt} = \Delta H_f$ − (other steps)**
- Hess: both routes have the **same total**
- **Keep every sign**



5 2+ ions, missing values

23.1.3, 23.1.4

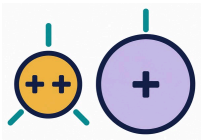
- 2+ ions: **IE_1 + IE_2**; double for two ions
- Oxides: **EA_1 (−) and EA_2 (+)**
- Missing value: the **same cycle, rearranged**
- e.g. EA_2 or ΔH_{at} from a known ΔH_{latt}



6 Charge and radius

23.1.5

- **Smaller** ions: closer, more exothermic
- **Higher charge**: much more exothermic
- 2+ with 2−: about **four times** the pull
- Down a group: less exothermic



The steps of a Born–Haber cycle

sodium fluoride; values in kJ mol⁻¹

Step	Equation	Value	Direction
$\Delta H_{at}(Na)$	$Na(s) \rightarrow Na(g)$	+107	up
$IE_1(Na)$	$Na(g) \rightarrow Na^+(g) + e^-$	+496	up
$\Delta H_{at}(F)$	$\frac{1}{2}F_2(g) \rightarrow F(g)$	+79	up
$EA_1(F)$	$F(g) + e^- \rightarrow F^-(g)$	−328	down
ΔH_{latt}	$Na^+(g) + F^-(g) \rightarrow NaF(s)$	−928	down
ΔH_f	$Na(s) + \frac{1}{2}F_2(g) \rightarrow NaF(s)$	−574	down

Worked examples

Lattice energy of NaF

- sum = 107 + 496 + 79 − 328
- = +354 kJ mol⁻¹
- ΔH_{latt} = −574 − 354 = **−928**

A missing value

- LiCl: ΔH_{latt} −861, ΔH_f −409
- $\Delta H_{at}(Cl)$ = −409 + 861 − 159 − 520 + 349
- = **+122 kJ mol⁻¹**

Charge beats radius

- NaCl −787; NaF −928 (smaller F^-)
- MgO −3791: 2+ and 2− ions
- values in kJ mol⁻¹

Lattice energy returns in the solution cycle (23.2).

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