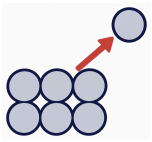
Lattice Energy Map

Edexcel International A Level Chemistry · Unit 4 · Topic 12B Lattice Energy and Born–Haber Cycles

1 Atomisation

12.12 i

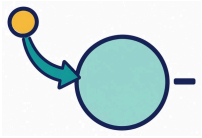
- **1 mol of gaseous atoms** from the element
- Na(s) → Na(g); **½Cl₂(g) → Cl(g)**
- ½ × bond enthalpy for gases
- Always **endothermic**



2 Electron affinity

12.12 ii

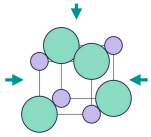
- **EA₁**: X(g) + e⁻ → X⁻(g)
- EA₁ **exothermic**: attracted to the nucleus
- **EA₂**: X⁻(g) + e⁻ → X²⁻(g)
- EA₂ **endothermic**: repelled by X⁻

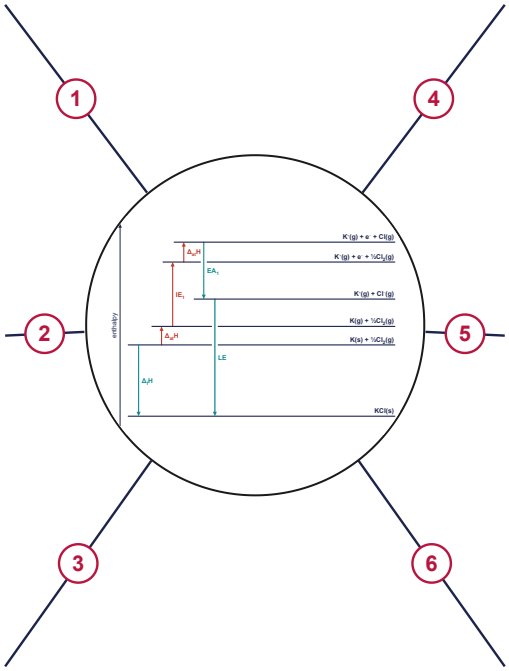


3 Lattice energy

12.12 iii

- **Gaseous ions → 1 mol of solid**
- K⁺(g) + Cl⁻(g) → KCl(s)
- **Exothermic**: ions attract
- Not measurable directly

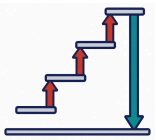




4 Born–Haber cycles

12.13

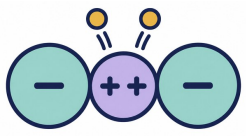
- Up: atomise, **ionise**; down: **EA**, **LE**
- ΔfH: elements straight to the solid
- **LE = ΔfH − (sum of the other steps)**
- A positive LE means a sign slip



5 2+ ions and oxides

12.13

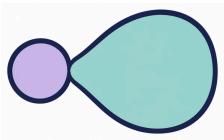
- 2+ ion: **IE₁ + IE₂**
- Two anions: **double** ΔatH and EA₁
- Oxides: **EA₁ (−) and EA₂ (+)**
- Any one missing value: rearrange



6 Covalent character

12.14, 12.15

- Theory: **perfect ionic model**
- Experimental more exothermic: **covalent**
- **Small, charged cation** polarises
- a **large anion**: compare by %



The steps of a Born–Haber cycle

sodium fluoride; values in kJ mol⁻¹

Step	Equation	Value	Direction
ΔatH(Na)	Na(s) → Na(g)	+107	up
IE₁(Na)	Na(g) → Na⁺(g) + e⁻	+496	up
ΔatH(F)	½F₂(g) → F(g)	+79	up
EA₁(F)	F(g) + e⁻ → F⁻(g)	−328	down
Lattice energy	Na⁺(g) + F⁻(g) → NaF(s)	−928	down
ΔfH	Na(s) + ½F₂(g) → NaF(s)	−574	down

Worked examples

Lattice energy of NaF

- sum = 107 + 496 + 79 − 328
- = +354 kJ mol⁻¹
- LE = −574 − 354 = **−928**

A missing value

- LiCl: LE −861, ΔfH −409
- ΔatH(Cl) = −409 + 861 − 159 − 520 + 349
- = **+122 kJ mol⁻¹**

Covalent character

- CaI_2: −2074 against −1905
- gap 8.9 %: **covalent character**
- large I^- polarised by Ca^{2+}

Lattice energy and hydration together decide the enthalpy change of solution (Topic 12C).

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