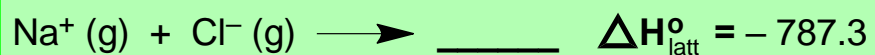


CONCEPT: LATTICE ENERGY

- **Lattice Formation Energy:** change in energy when separated gaseous ions combine to form an ionic _____.



- **Exothermic Reaction:** Reaction *releases* energy in order to create a bond.

- More _____ lattice energy value = more exothermic reaction.

EXAMPLE: The lattice formation of MgBr_2 is the energy change for which one of the following processes?

- I. $\text{Mg} (\text{s}) + \text{Br}_2 (\text{g}) \longrightarrow \text{MgBr}_2 (\text{s})$
- II. $\text{Mg} (\text{g}) + 2 \text{Br} (\text{g}) \longrightarrow \text{MgBr}_2 (\text{s})$
- III. $\text{Mg}^{2+} (\text{g}) + 2 \text{Br}^- (\text{g}) \longrightarrow \text{MgBr}_2 (\text{s})$
- IV. $\text{Mg}^{2+} (\text{g}) + 2 \text{Br}^- (\text{g}) \longrightarrow \text{MgBr}_2 (\text{g})$
- V. $\text{MgBr}_2 (\text{aq}) \longrightarrow \text{MgBr}_2 (\text{s})$

- a) I b) II c) III d) IV e) V

- **Lattice Dissociation Energy:** change in energy of _____ mole of solid crystal as it is scattered into gaseous ions.



- **Endothermic Reaction:** Reaction *absorbs* energy in order to create a bond.

- More _____ lattice energy value = more endothermic reaction.

EXAMPLE: Which of the following reactions is associated with the lattice dissociation of Li_2O ?

- I. $2 \text{Li}^+ (\text{g}) + \text{O}^{2-} (\text{g}) \longrightarrow \text{Li}_2\text{O} (\text{s})$
- II. $2 \text{Li} (\text{s}) + \text{O}_2 (\text{g}) \longrightarrow \text{Li}_2\text{O} (\text{s})$
- III. $2 \text{Li}^+ (\text{g}) + \text{O}^{2-} (\text{aq}) \longrightarrow \text{Li}_2\text{O} (\text{s})$
- IV. $\text{Li}_2\text{O} (\text{s}) \longrightarrow 2 \text{Li}^+ (\text{g}) + \text{O}^{2-} (\text{g})$
- V. $\text{Li}_2\text{O} (\text{s}) \longrightarrow \text{Li} (\text{g}) + \text{O}_2 (\text{g})$

- a) I b) II c) III d) IV e) V

CONCEPT: LATTICE ENERGY

Lattice Energy Formula

- By simplifying Coulomb's Law, a general formula for lattice energy can be used to determine ionic bond strength.

□ The ↑ the lattice energy then the _____ the ionic bond.

Lattice Energy

Lattice Energy Formula

$$\text{Lattice Energy} = \frac{Q_1 Q_2}{r} \propto \frac{|\text{Cation Charge} \cdot \text{Anion Charge}|}{\text{Cation Radius} + \text{Anion Radius}}$$

□ Radius of the ion = _____ or Row on the Periodic Table

EXAMPLE: Which compound possesses the strongest ionic bond: MgBr₂ or KCl?

PRACTICE: The lattice energy for ionic crystals decreases as the charge of the ions _____ and the size of the ions _____.

- a) Increases, increases b) Increases, decreases c) Decreases, increases d) Decreases, decreases

CONCEPT: LATTICE ENERGY

Physical Properties

- The lattice energy of an ionic solid has a direct impact on its physical properties.
 - Recall, an \uparrow in the lattice energy causes an ____ in the strength of an ionic bond.
 - An \uparrow in the lattice energy ____ the boiling point, ____ the melting point, and ____ the solubility.

EXAMPLE: Choose the compound below that should have the highest melting point according to the ionic bonding model.

a) AlN

b) NaF

c) MgO

d) NaCl

PRACTICE: Which of the following compounds would you expect to have the highest boiling point?

a) MgCl_2

b) SrO

c) SrCl_2

d) CsI

e) LiBr

PRACTICE: The solubilities of CaCrO_4 and PbCrO_4 in water at 25 °C are approximately 0.111 g/L and 0.0905 g/L in H_2O respectively. Based on this information, which compound do you think has the smaller lattice energy?