

Exercise 7.1a(H)

Lattice Energy

Name: _____

Date: _____ Per: _____

Lattice energy is the amount of energy released when gaseous ions react during the formation of a solid ionic compound; or, the amount of energy required to separate a solid ionic compound into its constituent gaseous ions. Depending on the chosen definition, the lattice energy of a given ionic compound may either be a positive or negative value. When the compound forms and energy is released, the process is exothermic, and the system loses energy so the lattice energy value would be negative. When the compound is separated, the process is endothermic as the system gains energy and the lattice energy would be positive. In either case, however, the quantity of energy would be the same. Lattice energies are reported in kilojoules per mole (kJ/mol).

The magnitude of the lattice energy of a solid depends on the charges of the ions, their sizes, and their arrangement in the solid. The potential energy of two interacting charged particles is given by:

$$F = \frac{Q_1 Q_2}{d}$$

Q_1 and Q_2 are the charges on the particles
 d is the distance between their centers

DIRECTIONS: Answer the following in the space provided.

- What two properties affect the lattice energy of an ionic compound? What is the relationship between each of these properties and lattice energy (i.e., are they inversely or directly related to lattice energy)?
 - _____
 - _____
- What physical properties does lattice energy affect? _____
- Does a stronger or weaker lattice energy result in a stronger ionic bond? How will this affect melting and boiling points of a crystal lattice? _____
- Determine (circle) which compound in each pair below will have a higher lattice energy. Defend your answer on the line to the right.
 - NaCl NaBr _____
 - KF CaF₂ _____
 - MgO Na₂O _____
 - KF CsCl _____
 - RbBr CaCl₂ _____

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DIRECTIONS: Using the table at right, answer the following in the space provided.

1. Mathematically compare the lattice energies of MgO and NaF.
- a. How do the lattice energies compare? _____

- b. Based on the charges of the ions in each and the lattice energy formula, what can you determine about the effect of ion size on the lattice energy of a compound? _____

Lattice Energies of Some Ionic Compounds				
Compound	Lattice Energy (kJ/mol)		Compound	Lattice Energy (kJ/mol)
LiF	1030		MgCl ₂	2326
LiCl	834		SrCl ₂	2127
LiI	730			
NaF	910		MgO	3795
NaCl	788		CaO	3414
NaBr	732		SrO	3217
NaI	682			
KF	808		ScN	7547
KCl	701			
KBr	671			
CsCl	657			
CsI	600			

2. Compare several compounds that share the same cation. What happens as the ionic radius of its complementary anion increases? _____

- a. How does this relate to the lattice energy formula? _____

- b. Does the pattern hold for compounds that share the same anion? Provide examples. _____

3. Compare two compounds that share the same anion but have cations of different charge.
- a. Which compounds are being compared? _____
- b. How do the lattice energies compare? _____
- c. How does this relate to the lattice energy formula? _____
4. What happens as the amount of charge on a single ion increases? _____

5. What happens as the amount of charge on both ions increase? _____

6. What do you think will be the effect of lattice energy on melting point? _____

7. What do you think will be the effect of lattice energy on solubility? _____
