

# Warm-up 2/24

1. Which reaction has an enthalpy change equal to a standard enthalpy change of formation,  $\Delta H_f^\ominus$ ?

All reactions occur at 298 K and  $1.01 \times 10^5$  Pa.

- A.  $\text{C}_4\text{H}_{8(g)} + \text{H}_2\text{O}_{(g)} \rightarrow \text{C}_4\text{H}_9\text{OH}_{(l)}$
- B.  $4\text{CO}_{2(g)} + 5\text{H}_2\text{O}_{(g)} \rightarrow \text{C}_4\text{H}_9\text{OH}_{(l)} + \text{O}_2(g)$
- C.  $4\text{C}(s) + 5\text{H}_2(g) + 1/2 \text{O}_2(g) \rightarrow \text{C}_4\text{H}_9\text{OH}_{(l)}$
- D.  $8\text{C}(s) + 10\text{H}_2(g) + \text{O}_2(g) \rightarrow 2\text{C}_4\text{H}_9\text{OH}_{(l)}$

2. What is the IB definition of Ionization Energy,  $\Delta H_{IE}$ ?

Standard enthalpy change that occurs on the removal of 1 mole of electrons from 1 mole of atoms or cations in the gaseous phase.

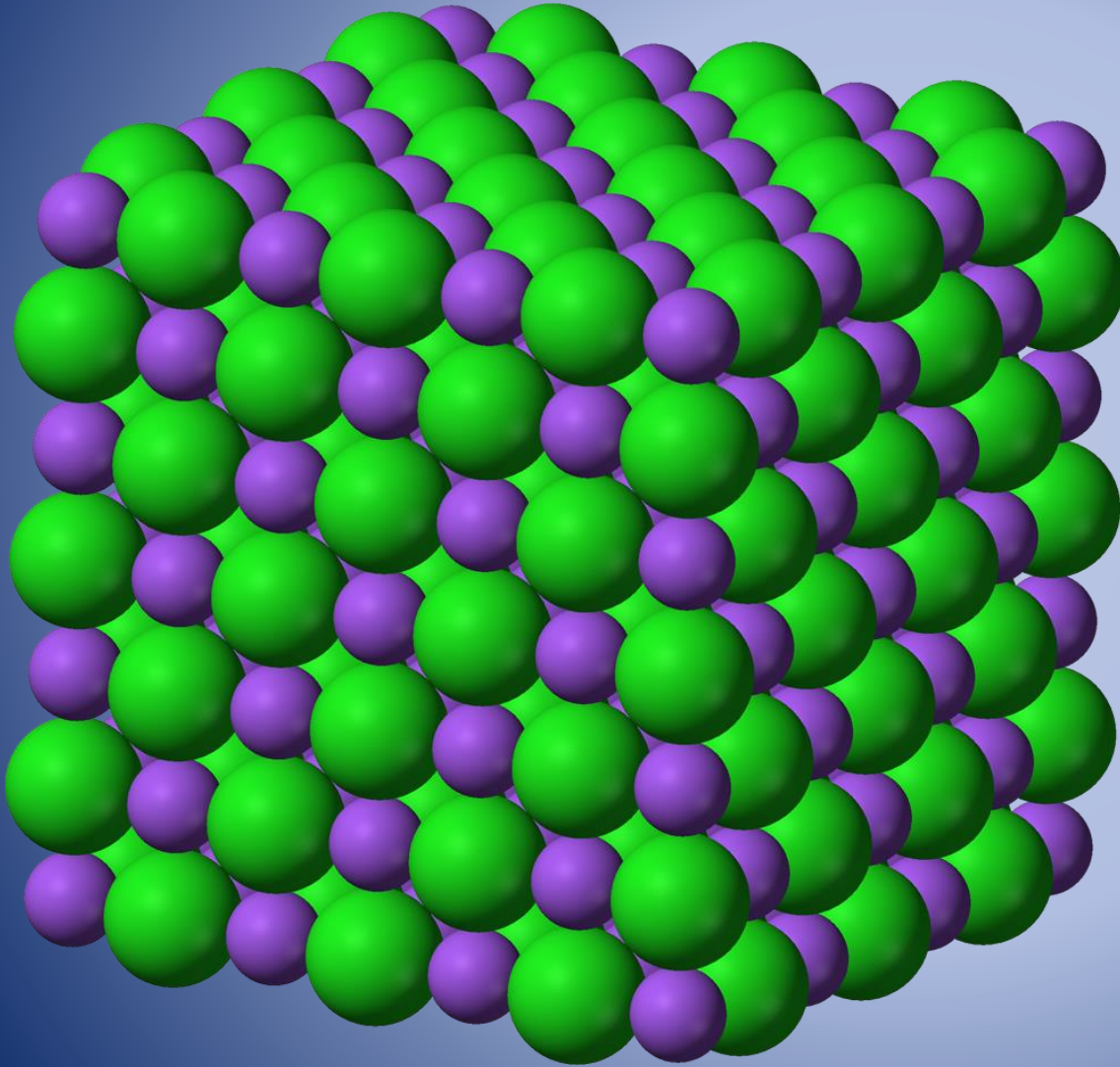
- **Obtain a data booklet and find enthalpies of formation, combustion, first ionization energy and electron affinity.**

# A Few Reminders

- IA due 11:59 pm
  - Copy in Hapara folder
  - OFFICIAL copy to me.
    - Hard copy OR
    - **Email** me copy (Word)
  
- Test revisions due by end of next Friday
  - Don't wait until the last minute!

# 15.1 Born-Haber Cycle

# Now to Ionic Compounds-yipee!!!



Describe the process of forming ionic compounds, starting with elements in their standard state.

# Lattice Enthalpy

- Enthalpy change that occurs when 1 mole of a solid ionic crystal is broken into its ions in the gaseous state.



- Endothermic or exothermic?
- If Standard Lattice Enthalpy what does this mean?
- Can be the opposite as well....
- Data booklet table 18

# Standard Enthalpy Change of Atomization

- Enthalpy required to produce 1 mole of gaseous atoms of an element from the element in its standard state.
- $\text{Na}_{(s)} \rightarrow \text{Na}_{(g)} \quad \Delta H^{\circ}_{\text{at}} = +103 \text{ kJ/mol}$
- $\frac{1}{2} \text{Cl}_{2(g)} \rightarrow \text{Cl}_{(g)} \quad \Delta H^{\circ}_{\text{at}} = ?$



# Electron Affinity

- Enthalpy change when one mole of gaseous atoms or anions gains 1 mole of electrons.
- Endothermic or exothermic?
- $\text{Cl} + \text{e}^- \longrightarrow \text{Cl}^- \quad \Delta H_{ea}^\circ = -349 \text{ KJ/mol}$
- $\text{O}^- + \text{e}^- \longrightarrow \text{O}^{2-} \quad \Delta H_{ea}^\circ(2^{\text{nd}}) = +753 \text{ KJ/mol}$

# Properties of Ions and Lattice Energy

- Remember it's all about pulling the oppositely charged ions apart.
- What types of ions would have a higher lattice energy?
  - Size-bigger or smaller?
  - Charge-larger or smaller?
- Data booklet (Table 18) – shows endothermic values.
  - If ionic radius increases, lattice enthalpies become less positive (i.e. it will take less energy to break the bonds)



# Equation Showing Properties and Lattice Enthalpies

$$\text{Lattice Enthalpy} \propto \frac{\text{(charge on positive ion)} \times \text{(charge on negative ion)}}{\text{Sum of the ionic radii}}$$

# Warm-up 2/27

1. Which equation corresponds to the lattice enthalpy for silver iodide, AgI?



# Schedule

- Thursday
- Unavailable after school tomorrow
- Next Friday = Topic 5/15 (and 16.2) Exam
- You have through this Friday to complete revisions on our last exam

# Born-Haber Cycle

- Shows process of going from elements in their gaseous state (or standard state) to a crystal lattice.
  - Requires many steps
  - Hess's cycle

# Construct a Born-Haber Cycle #1

- Make NaCl(s) from standard state elements
  - $\text{Na}_{(s)} \rightarrow \text{Na}_{(g)} \quad \Delta H^{\circ}_{\text{at}} = +103 \text{ kJ/mol}$

# Construct a Born-Haber Cycle #2

- Construct Sodium Oxide from standard state elements given:
- $\Delta H^\circ_{f \text{ Na}_2\text{O}} = -414 \text{ kJ/mol}$
- $\Delta H^\circ_{\text{atom Na}} = 103 \text{ kJ/mol}$
- Use the data booklet to find the rest and solve for the Lattice Enthalpy of  $\text{Na}_2\text{O}$



# HW 15.1 WS

- #4-6