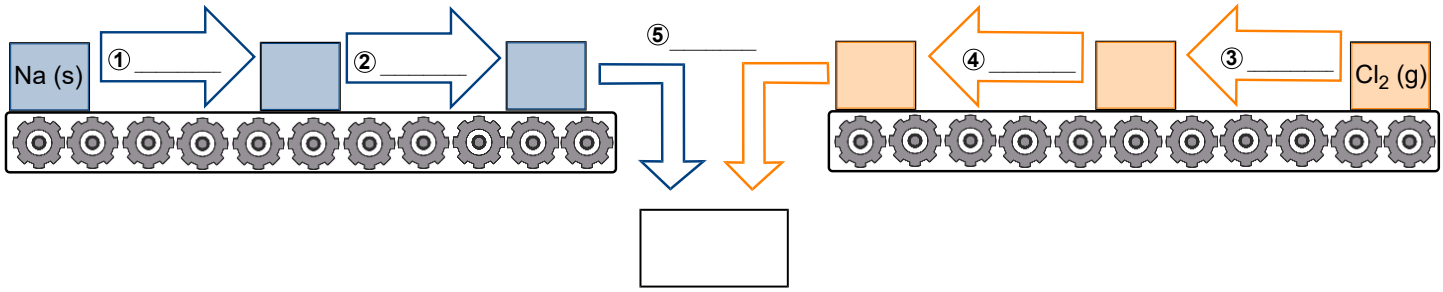
CONCEPT: BORN-HABER CYCLE

- A reaction outline that gives the steps for the formation of an ionic compound from the standard states of its elements.
  - □ Recall, a *formation equation* shows the standard states of elements combining to form _____ mole of product.
    - Associated with a formation equation is its enthalpy of formation _____.

$$Na\ (s) + \frac{1}{2} Cl_2\ (g) \longrightarrow NaCl\ (s) \quad \Delta H_f^o = -411 \frac{kJ}{mol}$$

- In order to calculate the enthalpy of formation, both elements must be converted into their ionic gaseous forms.



- By combining all the steps, the enthalpy of formation can be determined.

Born-Haber Cycle

ΔH_f^o = ① _____ + ② _____ + ③ _____ + ④ _____ + ⑤ _____

EXAMPLE: When setting up the steps of the Born-Haber Cycle for K_2O, how many ionization energies (IE) and how many electron affinities (EA) do you need?

a) 2 IE, 0 EA b) 2 IE, 1 EA c) 1 IE, 2 EA d) 1 IE, 1 EA e) 2 IE, 2 EA

CONCEPT: BORN-HABER CYCLE

PRACTICE: Using the Born-Haber Cycle, demonstrate the formation of cesium chloride, CsCl, and calculate its enthalpy of formation.

Born-Haber Cycle Values

Term	Value kJ / mol
$\Delta H_{Sublimation}$	79
IE_1	376
$\Delta H_{B.E.}$	122
EA_1	– 349
ΔH^{o}_{Latt}	– 661

PRACTICE: Calculate the lattice energy for the following formation equation:

$$Ba\ (s)\ +\ Br_2\ (g) \longrightarrow BaBr_2\ (s)$$

Born-Haber Cycle Values

Term	Value kJ / mol
$\Delta H_{Sublimation}$	178
IE_1	503
IE_2	965
EA_1	– 325
$\Delta H_{B.E.}$	193
ΔH^{o}_{f}	– 909