MOLECULAR STRUCTURE & BONDING - 1

Chpt. 9

Chang - p. 406 #9.15, 9.18, 9.19, 9.23, 9.25, 9.26 (6 prob)

9.15 @ doubling r_{A^+} would decrease the bond strength (if dist. from nucleus A+ to nucleus of B^- were doubled, we could say that the bond strength would be cut in half, but we cannot be that specific here.)

ⓑ Tripling the charge on the cation triples the bond strength

@ Doubling the charges on both ions quadruples the bond strength

ⓓ Decreasing both radii to half would double the bond strength

9.18

$Sr + Se \rightarrow SrSe$ $\quad \cdot\ddot{S}r\cdot + \cdot\ddot{S}e\cdot \rightarrow Sr^{+}:\ddot{S}e:^{-}$

$Ca + H_2 \rightarrow CaH_2$ $\quad \cdot Ca\cdot + H\cdot\cdot H \rightarrow H:^{-}\ Ca^{2+}\ :H^{-}$

$6Li + N_2 \rightarrow 2Li_3N$ $\quad 6Li^{\bullet} + 2:\dot{N}\cdot \rightarrow 6Li^{+} + 2:\ddot{N}:^{3-}$

$2Al + 3S \rightarrow Al_2S_3$ $\quad 2\cdot\dot{A}l\cdot + 3\cdot\ddot{S}\cdot \rightarrow 2Al^{3+} + 3:\ddot{S}:^{2-}$

9.19 @ I & Cl → covalent I–Cl (ICl) iodine monochloride

ⓑ Mg & F → ionic $:\ddot{F}:^{-}\ Mg^{2+}\ :\ddot{F}:^{-}$ (MgF_2) magnesium fluoride

9.23 @ KCl or (MgO) (expl: MgO has greater charges AND smaller radii)

ⓑ (LiF) or LiBr (expl: Same charges, F^- has a smaller radius than Br^-)

@ (Mg_3N_2) or NaCl (expl: Mg_3N_2 has greater charges AND smaller radii)

Chang - Chpt. 9 (cont.)

9.25 $Na_{(s)} + \frac{1}{2}Cl_{2(g)} \rightarrow NaCl_{(s)}$ $\Delta H_f^\circ = -411$ KJ/mol (This is the total energy change for the entire process!)

① Sublime the sodium

$Na_{(s)} \rightarrow Na_{(g)}$ (takes) +108 KJ/mol

② Break the bonds in ½ mol of Cl_2

$\frac{1}{2}Cl_{2(g)} \rightarrow Cl_{(g)}$ (takes) +121.4 KJ (per half mol) (242.7 Bond Energy ÷ 2)

③ Ionize the sodium (1st Ionization Energy)

$Na_{(g)} \rightarrow Na^+_{(g)} + e^-$ (takes) +495.9 KJ/mol

④ Ionize the chlorine (electron affinity)

$Cl_{(g)} + e^- \rightarrow Cl^-_{(g)}$ (releases) −349 KJ/mol

⑤ Allow the ions to combine to form an ionic lattice

$Na^+_{(g)} + Cl^-_{(g)} \rightarrow NaCl_{(s)}$ (releases) ? (lattice energy)

① + ② + ③ + ④ + ⑤ → TOTAL

$+108\text{ KJ} + 121.4\text{ KJ} + 495.9\text{ KJ} + (-349\text{ KJ}) + (-x) = -411\text{ KJ}$

$376.3\text{ KJ} + x = -411\text{ KJ}$

$376.3\text{ KJ} + 411\text{ KJ} = -x = -787.3\text{ KJ/mol}$

$-x = +787.3$ KJ so

9.26 $Ca_{(s)} + Cl_{2(g)} \rightarrow CaCl_{2(s)}$

① $Ca_{(s)} \rightarrow Ca_{(g)}$ +121 KJ/mol

② $Cl_{2(g)} \rightarrow 2Cl_{(g)}$ +242.7 KJ/mol

1st AND 2nd ③ $Ca_{(g)} \rightarrow Ca^{2+}_{(g)} + 2e^-$ +589.5 KJ/mol, +1145 KJ/mol

④ $2Cl_{(g)} + 2e^- \rightarrow 2Cl^-$ 2 × (−349 KJ/mol)

} +1400.2 KJ

⑤ $Ca^{2+}_{(g)} + 2Cl^-_{(g)} \rightarrow CaCl_{2(s)}$?

−795 KJ/mol

$+1400.2\text{ KJ} + x = -795\text{ KJ/mol}$

$-x = +2195.2$ so $x = -2195.2$ KJ*

KJ/mol means per mol of product or of "the reaction"