Using electron dot diagrams, we can show the formation of an ionic bond between sodium and chlorine.

$$Na\cdot + \cdot\ddot{\underset{\cdot\cdot}{Cl}}: \rightarrow [Na]^{+}\ [:\ddot{\underset{\cdot\cdot}{Cl}}:]^{-}$$

When illustrating the formation of an ionic bond, we place square brackets around the ion to indicate that the charge is not associated with any particular electron and that all the electrons in the valence shell are equivalent.

We can use the periodic table and electron dot diagrams to predict the formulas of other ionic compounds. By finding out how many electrons they tend to lose or gain to reach stable octets, we can figure out what ratio of ions will make an electrically neutral compound.

As an example, suppose we were asked to draw electron dot diagrams to illustrate the formation of calcium fluoride, state the ratio of ions in the compound, and give the formula for the compound. Calcium is in Group 2, so will form an ion with a charge of 2+. Fluorine is in Group 17, so will form an ion with a charge of 1−.

$$\cdot Ca\cdot + 2\ :\dot{\underset{\cdot\cdot}{F}}: \rightarrow [:\ddot{\underset{\cdot\cdot}{F}}:]^{-}\ [Ca]^{2+}\ [:\ddot{\underset{\cdot\cdot}{F}}:]^{-}$$

To form an electrically neutral ionic compound, the ratio of calcium to fluoride ions is 1:2. The formula is CaF_2.

Sample Problem

Draw electron dot diagrams to illustrate the formation of magnesium oxide. Write the ion ratio and the chemical formula.

Solution

$$\cdot Mg\cdot + :\ddot{\underset{\cdot}{O}}\cdot \rightarrow [Mg]^{2+}\ [:\ddot{\underset{\cdot\cdot}{O}}:]^{2-}$$

The two elements will combine in a ratio of 1:1. The formula is MgO.

Practice

Understanding Concepts

8. (a) How do the electron dot diagrams of metal ions differ from those of nonmetal ions?
   (b) How are the electron dot diagrams of metal ions similar to those of nonmetal ions?
9. Use electron dot diagrams to illustrate the formation of
   (a) lithium iodide
   (b) barium chloride
   (c) potassium oxide
   (d) calcium fluoride
10. Represent each of the following elements using electron dot diagrams:
   (a) nitrogen
   (b) sulfur
   (c) argon
   (d) iodine
   (e) lithium
   (f) cesium
   (g) calcium
   (h) sodium