Goal • Learn an alternative method for writing formulas and determining cation charges.

What to Do
Review the crossover method, go through each model problem, and complete each practice problem in the space provided.

The Method
The crossover method is a shortcut that can help you determine the formula of an ionic compound. To use the crossover method, follow the steps below:

1. Write the formulas of the ions beside each other.
2. Cross over the magnitude (amount or size) of the charge on the cation so that it is the subscript for the anion.
3. Cross over the magnitude of the charge on the anion so that it is the subscript for the cation.
4. Reduce to lowest terms if necessary.
5. Check your formula.

Model Problem 1
Determine the formula of each compound.
(a) magnesium chloride
(b) calcium oxide

Solution
(a) You determine the subscripts by crossing over the magnitudes of the charges. Remember that you do not write the number 1.

\[
\text{MgCl}_2
\]
magnesium chloride

Check the formula by adding the charges on the ions.
\[+2 + [2 \times (-1)] = 0\]
The total charge is zero. The formula is correct.

(b) Because a formula shows the ratio of ions, you must write the simplest ratio. For calcium oxide, the simplest ratio of ions is 1:1.

\[
\text{Ca}_2\text{O}_2
\]
calcium oxide

Check the formula by adding the charges on the ions: \[+2 + (-2) = 0\]
The total charge is zero. The formula is correct.
SKILL BUILDER The Crossover Method (continued)

Practice Problem
1. Use the crossover method to write the formula of each compound. Show your work.

(a) calcium bromide

(b) lithium oxide

(c) iron(III) chloride

(d) cobalt(II) sulfide

The Reverse Method
You can use the reverse of the crossover method to determine the charge of a transition metal cation in an ionic compound.

Model Problem 2
Determine the charge on Fe in each compound.
(a) FeCl₃
(b) FeO
Solution
(a) Use the reverse of the crossover method.
Remember that you do not write the number 1.
Add the charge signs to each ion.

Check your answer. The charge on Cl is correct (1–), therefore the cation charge must be correct.
In FeCl₃, the iron cation is Fe³⁺.

(b) Use the reverse of the crossover method.
Add the charge signs to each ion.

Check your answer. The charge on O is incorrect. The oxygen anion should be 2–, not 1–. You need to double the charge on each ion. Therefore, the iron cation in FeO is Fe²⁺.

Practice Problem
2. Use the reverse crossover method to determine the charge on the cation in each compound. Show your work.

(a) Cu₂O

(b) NiBr₂

(c) PdO

(d) TiO₂