A coefficient multiplies the number of atoms of each element indicated in a chemical formula. Thus, $2H_2O$ represents *four* H atoms and *two* O atoms. To add two more hydrogen atoms to the right side of the equation, one may be tempted to change the subscript in the formula of water so that H_2O becomes H_4O. However, this would be a mistake because changing the subscripts of a chemical formula changes the *identity* of the compound. H_4O is not a product in the combustion of methane. In fact, there is no such compound. One must use only coefficients to change the relative number of atoms in a chemical equation because coefficients change the numbers of atoms without changing the identities of the reactants or products.

Now consider the number of oxygen atoms. There are four oxygen atoms on the right side of the arrow in the partially balanced equation. Yet there are only two oxygen atoms on the left side of the arrow. One can increase the number of oxygen atoms on the left side to four by placing the coefficient 2 in front of the molecular formula for oxygen. This results in a correct chemical equation, or *balanced formula equation,* for the burning of methane in oxygen.

$$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g)$$
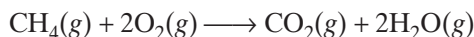
This reaction is further illustrated in **Figure 3.**

Additional Symbols Used in Chemical Equations

Table 2 on the next page summarizes the symbols commonly used in chemical equations. Sometimes a gaseous product is indicated by an arrow pointing upward, $\uparrow$, instead of (*g*), as shown in the table. A downward arrow, $\downarrow$, is often used to show the formation of a precipitate during a reaction in solution.

The conditions under which a reaction takes place are often indicated by placing information above or below the reaction arrow. The word *heat,*

(a)

(b)

Molecules	CH_4	+	$2O_2$		CO_2	+	$2H_2O$
Atoms	(1C, 4H)	+	(4O)		(1C, 2O)	+	(4H, 2O)

FIGURE 3 (a) In a Bunsen burner, methane combines with oxygen in the air to form carbon dioxide and water vapor. (b) The reaction is represented by both a molecular model and a balanced equation. Each shows that the number of atoms of each element in the reactants equals the number of atoms of each element in the products.