	P	Q	Z
0	0	0	0
1	0	1	1
2	1	0	1
3	1	1	1

$Z = \Sigma_m\ 1, 2, 3$

Z:

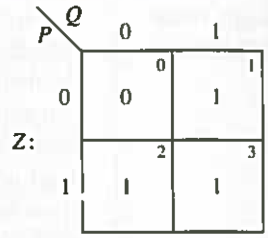

Figure 3–44
A two-variable truth table and its K-map configuration.

3–44 that the value inside each cell is the value of the dependent variable Z, and the coordinates of each cell are the values of the independent variables P and Q.

Before we can obtain the logic equation from the K-map we must first define the *adjacency* of two cells in a K-map. Two cells are said to be *adjacent* if *only one independent variable changes in going from one cell to the other*. For example, in Figure 3–43, cell no. 0 and cell no. 1 are adjacent because the variable B changes from a 0 to a 1 (or a 1 to a 0) but the variable A remains the same (0) in both cells. Similarly, cell no. 1 and cell no. 3 are adjacent because A changes from a 0 to a 1 (or a 1 to a 0) but the variable B remains the same (1) in both cells. Notice that cell no. 1 and cell no. 2 are *not* adjacent because both variables A and B change in going from one cell to the other—in going from cell no. 1 to cell no. 2, B changes from a 1 to a 0 and A changes from a 0 to a 1. Similarly, cell no. 0 and cell no. 3 are not adjacent.

There are two methods of using a K-map. The first involves combining all the cells containing 1's (1-cells) to obtain a simplified sum-of-products equation, and the other involves combining all the cells containing 0's (0-cells) to obtain the product-of-sums equation. Notice that this procedure is similar to the procedure used to obtain the *unsimplified* sum-of-products and product-of-sums equation from a truth table. We shall first examine the sum-of-products procedure and then apply the concepts developed to the product-of-sums procedure discussed at the end of this section.

Figure 3–45a shows a K-map representation of a truth table containing two 1's for the dependent variable P. Notice that these two 1's are located in cells that are *not* adjacent. This means that simplification is *not possible*, and we must take the sum of the minterms corresponding to these two 1's. The *unsimplified* equation is

$$P = \overline{X}\,\overline{Y} + XY$$

Similarly, in Figure 3–45b, the two 1-cells are not adjacent and therefore no simplification is possible, and the unsimplified logic equation for the K-map is

$$P = X\overline{Y} + \overline{X}Y$$

If a K-map contains a single 1-cell then the equation will contain only the minterm for that cell.

Simplification is only possible in K-maps that have logic 1's located in cells that are adjacent. For example, in Figure 3–46a, since there are