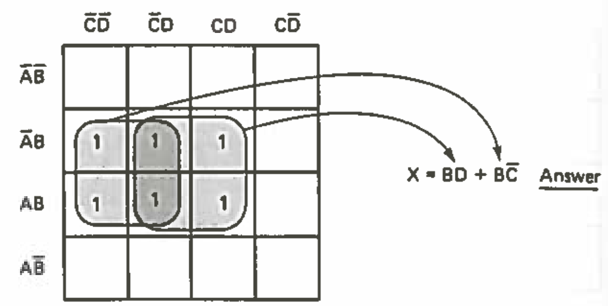

Figure 3–41 Solution to Example 3–16.

EXAMPLE 3–17

Simplify the following equation using the Karnaugh mapping procedure:

$$X = \overline{A}\overline{B}\overline{C} + A\overline{C}\overline{D} + A\overline{B} + ABC\overline{D} + \overline{A}\overline{B}C$$

Solution:

Note in Figure 3–42 that a new technique called *wraparound* is introduced. You have to think of the K-map as a continuous cylinder in the horizontal direction, like the label on a soup can. This makes the left row of cells adjacent to the right row of cells. Also, in the vertical direction, a continuous cylinder like a soup can lying on its side makes the top row of cells adjacent to the bottom row of cells. In Figure 3–42, for example, the four top cells are adjacent to the four bottom cells, to combine as eight cells having the variable $\overline{B}$ in common.

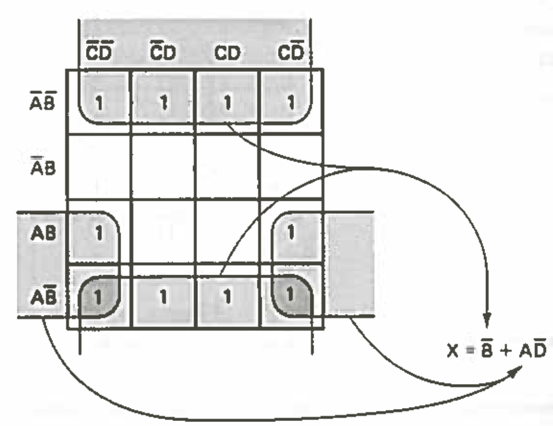

Figure 3–42 Solution to Example 3–17 illustrating the wraparound feature.

Another circle of four is formed by the wraparound adjacencies of the lower-left and lower-right pairs combining to have $A\overline{D}$ in common. The final equation becomes $X = \overline{B} + A\overline{D}$. Compare that simple equation with the original equation that had five terms in it.

EXAMPLE 3–18

Simplify the following equation using the Karnaugh mapping procedure:

$$X = \overline{B}(CD + \overline{C}) + C\overline{D}(\overline{A + B} + AB)$$

Solution:

Before filling in the K-map, an SOP expression must be formed:

$$X = \overline{B}CD + \overline{B}\overline{C} + C\overline{D}(\overline{A}\overline{B} + AB)$$
$$= \overline{B}CD + \overline{B}\overline{C} + \overline{A}\overline{B}C\overline{D} + ABC\overline{D}$$

The group of four 1s can be encircled to form $\overline{A}\overline{B}$, as shown in Figure 3–43. Another group of four can be encircled using wraparound to form $\overline{B}\overline{C}$. That leaves two 1s that are not combined with any others. The unattached 1 in the bottom row can be combined within a group of four, as shown, to form $\overline{B}D$.

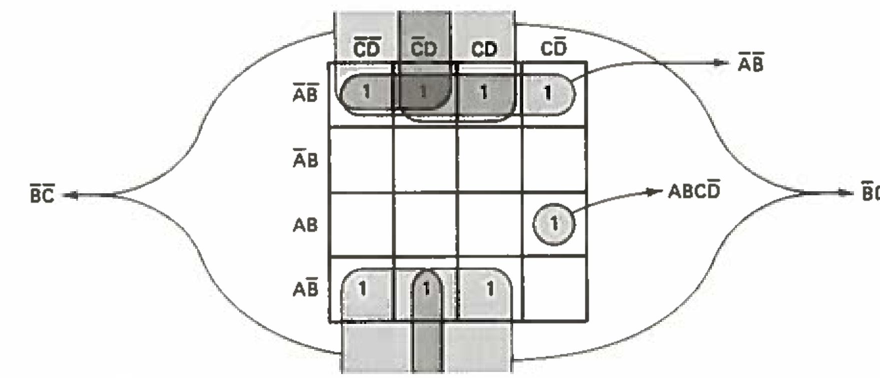

Figure 3–43 Solution to Example 3–18.

The last 1 is not adjacent to any other, so it must be encircled by itself to form $ABC\overline{D}$. The final simplified equation is

$$X = \overline{A}\overline{B} + \overline{B}\overline{C} + \overline{B}D + ABC\overline{D}$$

EXAMPLE 3–19

Simplify the following equation using the Karnaugh mapping procedure:

$$X = \overline{A}\overline{D} + A\overline{B}\overline{D} + \overline{A}\overline{C}D + \overline{A}CD$$

Solution:

First, the group of eight cells can be encircled, as shown in Figure 3–44. $\overline{A}$ is the only variable present in each cell within the circle, so that the circle of eight simply reduces to $\overline{A}$. (Note that larger circles will reduce to fewer variables in the final equation.)

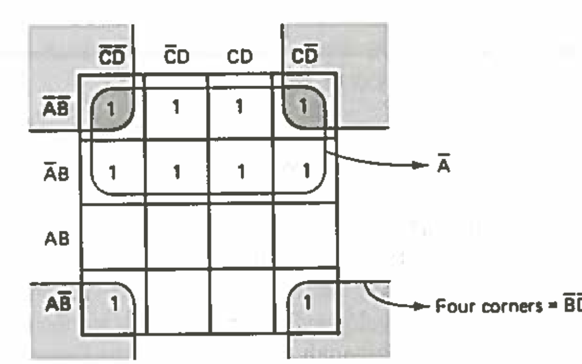

Figure 3–44 Solution to Example 3–19.