Solution: First, the group of eight cells can be encircled, as shown in Figure 5–74. $\overline{A}$ is the only variable present in each cell within the circle, so the circle of eight simply reduces to $\overline{A}$. (Notice that larger circles will reduce to fewer variables in the final equation.)
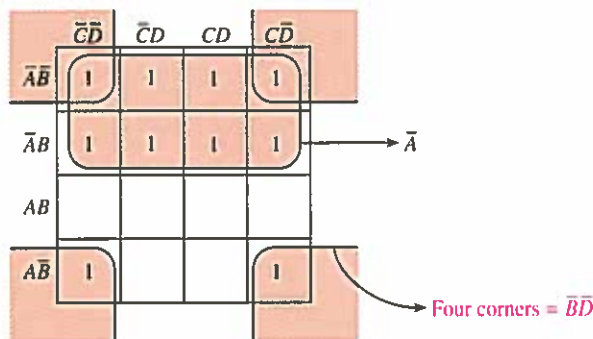

Figure 5–74 Solution to Example 5–28.

Also, all four corners are adjacent to each other because the K-map can be wrapped around in both the vertical *and* horizontal directions. Encircling the four corners results in $\overline{B}\,\overline{D}$. The final equation is

$$X = \overline{A} + \overline{B}\,\overline{D}$$

EXAMPLE 5–29

Simplify the following equation using the Karnaugh mapping procedure:
$$X = \overline{A}\,\overline{B}\,\overline{D} + A\overline{C}\,\overline{D} + \overline{A}\,B\overline{C} + AB\overline{C}D + A\overline{B}C\overline{D}$$

Solution: Encircling the four corners forms $\overline{B}\,\overline{D}$, as shown in Figure 5–75. The other group of four forms $B\overline{C}$. You may be tempted to encircle the $\overline{C}\,\overline{D}$ group of four as shown by the dotted line, but that would be **redundant** because each of those 1's is already contained within an existing circle. Therefore, the final equation is
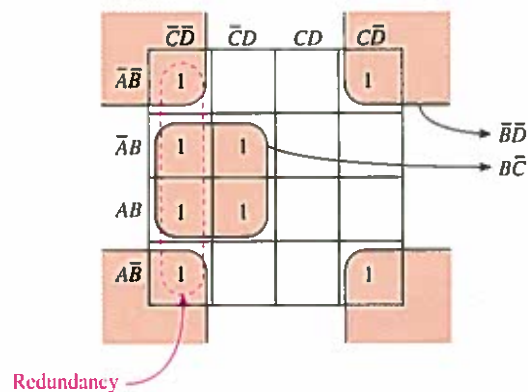
$$X = \overline{B}\,\overline{D} + B\overline{C}$$

Figure 5–75 Solution to Example 5–29.