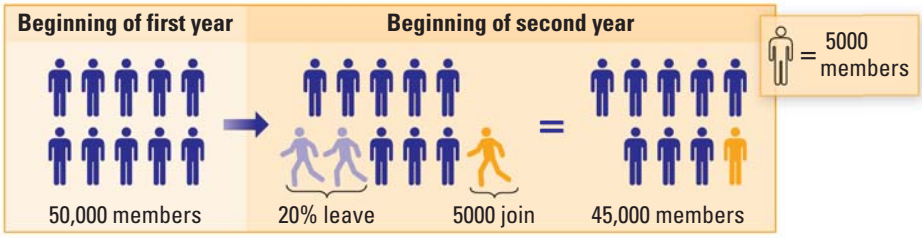
EXAMPLE 4 TAKS REASONING: Multi-Step Problem

MUSIC SERVICE An online music service initially has 50,000 annual members. Each year it loses 20% of its current members and adds 5000 new members.



- Write a recursive rule for the number a_n of members at the start of the nth year.
- Find the number of members at the start of the 5th year.
- Describe what happens to the number of members over time.

ANOTHER WAY
For alternative methods for solving the problem in Example 4, turn to page 834 for the **Problem Solving Workshop**.

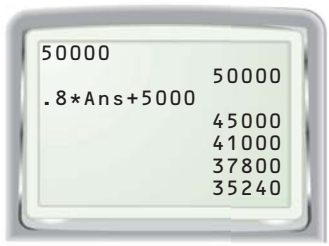
Solution

STEP 1 **Write** a recursive rule. Because the number of members declines 20% each year, 80% of the members are retained from one year to the next. Also, 5000 new members are added each year.

Members at start of year n	$=$	0.8	$\cdot$	Members at start of year $(n-1)$	$+$	New members added
$\downarrow$				$\downarrow$		$\downarrow$
a_n	$=$	0.8	$\cdot$	a_{n-1}	$+$	5000

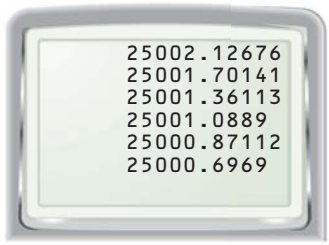
▶ A recursive rule is $a_1 = 50{,}000$, $a_n = 0.8a_{n-1} + 5000$.

STEP 2 **Find** the number of members at the start of the 5th year. Enter 50,000 (the value of a_1) into a graphing calculator. Then enter the rule $0.8 \times \text{Ans} + 5000$ to find a_2. Press ENTER three more times to find a_5.



▶ There are about 35,240 members at the start of the 5th year.

STEP 3 **Describe** what happens to the number of members over time. Continue pressing ENTER on the calculator. As shown at the right, after many years the number of members approaches 25,000.



▶ The number of members stabilizes at about 25,000 members.

GUIDED PRACTICE for Examples 3 and 4

9. Write a recursive rule for the sequence 1, 2, 2, 4, 8, 32, ...

10. **WHAT IF?** In Example 4, suppose 70% of the members are retained each year. What happens to the number of members over time?