MULTIPLE EVENTS When finding the number of ways both an event A *and* an event B can occur, you need to multiply, as in part (b) of Example 1. When finding the number of ways that event A *or* event B can occur, you add instead.

EXAMPLE 2 Decide to multiply or add combinations

THEATER William Shakespeare wrote 38 plays that can be divided into three genres. Of the 38 plays, 18 are comedies, 10 are histories, and 10 are tragedies.

a. How many different sets of *exactly* 2 comedies and 1 tragedy can you read?

b. How many different sets of *at most* 3 plays can you read?

AVOID ERRORS
When finding the number of ways to select *at most n* objects, be sure to include the possibility of selecting 0 objects.

Solution

a. You can choose **2** of the **18** comedies and **1** of the **10** tragedies. So, the number of possible sets of plays is:

$$_{18}C_2 \cdot {}_{10}C_1 = \frac{18!}{16! \cdot 2!} \cdot \frac{10!}{9! \cdot 1!} = \frac{18 \cdot 17 \cdot \cancel{16!}}{\cancel{16!} \cdot 2 \cdot 1} \cdot \frac{10 \cdot \cancel{9!}}{\cancel{9!} \cdot 1} = 153 \cdot 10 = 1530$$

b. You can read **0**, **1**, **2**, or **3** plays. Because there are **38** plays that can be chosen, the number of possible sets of plays is:

$$_{38}C_0 + {}_{38}C_1 + {}_{38}C_2 + {}_{38}C_3 = 1 + 38 + 703 + 8436 = 9178$$

SUBTRACTING POSSIBILITIES Counting problems that involve phrases like "at least" or "at most" are sometimes easier to solve by subtracting possibilities you do not want from the total number of possibilities.

EXAMPLE 3 TAKS REASONING: Multi-Step Problem

BASKETBALL During the school year, the girl's basketball team is scheduled to play 12 home games. You want to attend *at least* 3 of the games. How many different combinations of games can you attend?

Solution

Of the **12** home games, you want to attend **3** games, or **4** games, or **5** games, and so on. So, the number of combinations of games you can attend is:

$$_{12}C_3 + {}_{12}C_4 + {}_{12}C_5 + \cdots + {}_{12}C_{12}$$

Instead of adding these combinations, use the following reasoning. For each of the **12** games, you can choose to attend or not attend the game, so there are 2^{12} total combinations. If you attend at least 3 games, you do not attend only a total of **0**, **1**, or **2** games. So, the number of ways you can attend at least 3 games is:

$$2^{12} - ({}_{12}C_0 + {}_{12}C_1 + {}_{12}C_2) = 4096 - (1 + 12 + 66) = 4017$$

GUIDED PRACTICE for Examples 1, 2, and 3

Find the number of combinations.

1. $_8C_3$ **2.** $_{10}C_6$ **3.** $_7C_2$ **4.** $_{14}C_5$

5. WHAT IF? In Example 2, how many different sets of *exactly* 3 tragedies and 2 histories can you read?