

Lesson 12-7

Example 1 Use a Permutation

- a. **Medals** How many ways can gold, silver, and bronze medals be awarded for a race run by 8 people?

When awarding medals, the order of finishing the race is important. This arrangement is a permutation.

$$P(8, 3) = 8 \cdot 7 \cdot 6 \\ = 336$$

8 choices for gold
7 choices for silver
6 choices for bronze

There are 336 possible ways to award the medals.

- b. How many five-digit zip codes can be made where all digits are unique? The possible digits are the numbers 0 – 9.

10 choices for the 1st digit
9 choices remain for the 2nd digit
8 choices remain for the 3rd digit
7 choices remain for the 4th digit
6 choices remain for the 5th digit

$$P(10, 5) = 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \\ = 30,240$$

Example 2 Factorial Notation

Find the value of 7!.

$$7! = 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 \quad \text{Multiply 7 and all of the counting numbers less than 7.} \\ = 5040$$

Example 3 Use a Combination

PIZZA How many ways can two slices of pizza be chosen from a plate containing one slice each of pepperoni, sausage, mushroom, and cheese pizza.

In choosing the slices of pizza, order is not important. This arrangement is a combination.

First, list all of the combinations of the different slices of pizza. Then cross off the arrangements that are the same as one another.

PS PM PC SP SM SC
MP MS MC CP CS CM

PS and SP are not different in this case, so cross off one of them.

There are six *different* arrangements left. So, there are six ways to choose two slices of pizza from the plate.

Example 4

COLORS How many ways can three colors be chosen from blue, red, green, and yellow, purple?

The arrangement is a combination because order is not important.

RGB BRY BGY ~~BGR~~ ~~BYR~~ ~~BYG~~ First, list all of the permutations. Then cross off the arrangements that are the same.
RGY ~~RGB~~ ~~RYB~~ ~~RYG~~ ~~RBG~~ ~~RBY~~
~~GYB~~ ~~GYR~~ ~~BGR~~ ~~GBY~~ ~~GRY~~ ~~GRB~~
~~YBR~~ ~~YBG~~ ~~YRG~~ ~~YRB~~ ~~YGB~~ ~~YGR~~

There are 4 ways to chose three colors from a list of four colors.

Example 5 Use a Combination to Solve a Problem

COMMITTEE Find the number of ways two co-chairpeople can be selected for a committee of 9 people.

Explore The committee has 9 people. Two need to be selected to be chairpeople.

Plan The order in which the people are selected is not important. This is a combination. Find the combination of 9 people taken 2 at a time.

Solve

$$C(9, 2) = \frac{P(9, 2)}{2!}$$
$$= \frac{9 \cdot 8}{2 \cdot 1} = 36$$

Examine List all the possible combinations of 2 people from the 9 on the committee. Check to see that there are 36 possible combinations.