Name _____ Class _____ Date _____

11-1 Reteaching

Permutations and Combinations

If you select some items out of a group and the order of the items in your selection is important, then your selection is a *permutation* of the group.

For example, suppose Ana, Bob, Cal, and Dan enter a local essay contest. Here are some possible ways for the judges to select the first-prize and second-prize winners.

First Prize	Second Prize
Ana	Bob
Dan	Cal
Bob	Ana
Bob	Dan

"Ana, Bob" means Ana is first and Bob is second.

"Bob, Ana" means Bob is first and Ana is second.

The order of the names in the selection is important. The selection "Ana, Bob" is a *permutation* of the group of contestants.

The number of permutations of n items of a set arranged r items at a time is

$$ {}_nP_r = \frac{n!}{(n-r)!}, (0 \le r \le n) $$

Problem

In how many ways can the judges select the first-prize and second-prize winners in the essay contest described above?

Step 1 Is the order of the names in each selection important?

Yes. "Ana, Bob" is not the same as "Bob, Ana." You are looking for the total number of permutations of 2 items each selected from a group of 4 items.

Step 2 Describe n and r.

There are 4 people in the group of contestants. $n = 4$

There are 2 people in each selection of prize winners. $r = 2$

Step 3 Substitute for each variable in the formula.

$$ {}_nP_r = {}_4P_2 = \frac{n!}{(n-r)!} = \frac{4!}{(4-2)!} = \frac{4!}{2!} = \frac{4 \cdot 3 \cdot \cancel{2 \cdot 1}}{\cancel{2 \cdot 1}} = 12 $$

There are 12 ways for the judges to choose the first-prize and second-prize winners.

Exercises

1. In how many ways can you choose 6 letters for a password from the set A, B, E, L, N, O, S, T, Y? **60,480**
2. In how many ways can a club with 15 members elect a president, vice president, secretary, and treasurer? **32,760**
3. In how many ways can a family of 6 line up in 1 row for a photograph? **720**

Name _____ Class _____ Date _____

11-1 Reteaching (continued)

Permutations and Combinations

If you select some items out of a group and the order of the items in your selection is NOT important, then your selection is a *combination* of the group.

For example, suppose Ana, Bob, Cal, and Dan enter a local essay contest. Two finalists will go to the statewide essay contest. Here are some ways for the judges to select the contestants who will go to the state contest.

Finalist	Finalist
Ana	Bob
Dan	Cal
Bob	Ana
Bob	Dan

"Ana, Bob" means both Ana and Bob will go.

"Bob, Ana" means both Ana and Bob will go.

The order of the names in the selection is NOT important. The selection "Ana, Bob" is a *combination* of the group of contestants.

The number of combinations of n items of a set chosen r items at a time is

$$_nC_r = \frac{n!}{r!(n-r)!}, \ (0 \le r \le n)$$

Problem

In how many ways can the judges select the finalists who will go to the state contest?

Step 1 Is the order of the names in each selection important?

No. "Ana, Bob" has the same meaning as "Bob, Ana." You are looking for the total number of combinations of 2 items each selected from a group of 4 items.

Step 2 Describe n and r.

There are 4 people in the group of contestants. $n = 4$

There are 2 people in each selection of contestants going on to state. $r = 2$

Step 3 Substitute for each variable in the formula.

$$_nC_r = {}_4C_2 = \frac{n!}{r!(n-r)!} = \frac{4!}{2!(4-2)!} = \frac{4!}{2!(2!)} = \frac{4 \cdot 3 \cdot \cancel{2 \cdot 1}}{2 \cdot 1(\cancel{2 \cdot 1})} = \frac{12}{2} = 6$$

There are 6 ways for the judges to choose the finalists going to the state contest.

Exercises

4. You have 12 CDs, but only have time to listen to 2 of them. How many combinations of CDs do you have to choose from? 66
5. Your biology teacher chooses 6 students from a class of 26 to do a special project. How many different groups can your teacher form? 230,230
6. How many 3-flavor blends can you create from 10 frozen yogurt flavors? 120