Date

Combinations CHAPTER

A combination is a grouping of objects in which the order of the objects does not matter.

EXAMPLE1 Compare permutations and combinations

Find the permutations and combinations of the letters X, Y, and Z taken 2 at a time.

Solution:

The *permutations* of these letters taken 2 at a time are:

XY YX YZ ZY XZ ZX

The *combinations* of these letters taken 2 at a time are:

XY or YXYZ or ZYZX or XZ

There are a total of 6 permutations, but only 3 combinations. This is because the order does not matter in a combination. In other words, XY and YX are considered to be the same in a combination.

Notice in the last example that the number of combinations is equal to the number of permutations, divided by 2. This is because we are dividing 6 (the number of permutations of 3 objects taken 2 at a time) by the number of permutations of 2 letters, which is equal to 2! = 2.

In general, the number of combinations of *n* objects taken *r* at a time is equal to the number of permutations of *n* objects taken *r* at a time, divided by *r*!. This can be written as follows:

$$\frac{n!}{(n-r)!} \div r! = \frac{n!}{(n-r)!} \cdot \frac{1}{r!} = \frac{n!}{r!(n-r)!}$$

KEY CONCEPT

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Combinations

Consider a set with *n* objects, and a subset of this set containing *r* objects. The number of combinations of *n* objects taken *r* at a time is given by:

 $\frac{n!}{r!(n-r)!}$

EXAMPLE2 Find the combination of 5 objects taken 3 at a time

Find the number of combinations of the letters A, B, C, D, and E taken 3 at a time.

Solution:

Using the formula, we have n = 5 and r = 3. Substitute these values into the formula.

$$\frac{5!}{3!(5-3)!} = \frac{5!}{3! \cdot 2!} = 10$$

So, there are a total of 10 combinations of 5 objects taken 3 at a time.

Date



- 6. Given the letters W, H, I, S, P, E, and R.
 - **a.** Find the number of permutations of these letters.
 - **b.** Find the number of combinations of these letters.
 - c. Find the number of permutations of these letters taken 4 at a time.
 - d. Find the number of combinations of these letters taken 4 at a time.
- 7. Given the letters P, E, N, C, I, and L.
 - **a.** Find the number of permutations of these letters.
 - **b.** Find the number of combinations of these letters.
 - c. Find the number of permutations of these letters taken 3 at a time.
 - d. Find the number of combinations of these letters taken 3 at a time.
- **8.** The number of combinations of the letters of the word CAKE taken *r* times is equal to 4. What is the value of *r*.

Pre-AP Copymasters