**Lesson 1.7 – Counting Principles**

**Learning Goal:** To be able to use solve problems using different counting techniques.

**Success Criteria:** I will know I have achieved the Learning Goal when I can... • explain the difference between AND and OR counting • define permutations and combinations • solve problems by applying different counting techniques

**AND counting:** If one action can be done m ways and another action can be done n ways, then  the number of ways one action AND the other action can be done is m x n. **OR counting:** If one action can be done m ways and another action can be done n ways, then  the number of ways one action OR the other action can be done is m + n. **Permutations:** The number of ways to arrange r objects out of n distinct objects, where order  is important. **Combinations**: The number of ways to arrange r objects out of n distinct objects, where order  is not important.

**Example**: An outfit must be selected that consists of a shirt and a pair of trousers. There are three choices for the shirt: a red, a blue and a green one. There are two choices for the trousers: jeans or corduroys.

1. List all the possible outfits.
2. Explain how the number of outfits can be found from the numbers of choices for the shirts and trousers.
3. Determine how the number of choices would change if you were told that an outfit consists of a shirt **or** a pair of trousers.

**Example**: There are twelve flights that can be taken from Frankfurt to Amsterdam on a given day, and there are three buses that can be taken from the Amsterdam airport to a hotel. Find the total number of ways in which the hotel in Amsterdam can be reached from Frankfurt using one of the flights and one of the buses.

**Example**: There are *x* flights and *x* +7 buses that can be taken from Mexico City to Guadalajara. Find *x* given that there is a total of 19 possible ways to get to Guadalajara from Mexico City by plane or by bus.

**Permutations**

There are \_\_\_\_\_\_\_ ways to arrange \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when order

The number of ways to arrange out of , where order

where *P* stands for “permutations”

**Example**: Find the number of different ways that four parked cars can be arranged in a straight line.

**Example**: A three-digit combination lock has three wheels, and on each wheel are all the integers from 0 to 9. Find the total number of possible codes for the lock.

A picture containing lock, wall, metalware, indoor

Description automatically generated

**Example**: Find the total number of different five-letter passwords that can be made from the 26 letters of the English alphabet if no letter can be used more than once.

**Example**: Lynx studies six subjects and has six textbooks, one for each class.

1. How many ways are there to arrange three of the six textbooks on a shelf?
2. Find how many ways there are to arrange all six books on a shelf such that the book for math and the book for physics are next to each other.

**Combinations**

Combinations are that can be made of out of if order .

**Example**: From a class of 25 students, a committee of 5 students to represent the class is to be chosen. If must include the class president. Find the number of ways that the committee can be selected.

**Example**: There are 8 girls and 5 boys on a volleyball team. Find the number of ways that the coach can choose a team of six players if it needs to have:

1. three boys and three girls
2. at least two boys and two girls

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