Multiplication Counting Principle:
The number of outcomes is the product of the number of choices for each step.

Factorial:
Is mostly used when you are using ALL of a given amount of items.

Permutation:
The number of outcomes when order DOES matter.

Combination:
The number of outcomes when order DOESN'T matter.

There are 24 students in the class.

How many ways could President, Vice-President, and Secretary be assigned?

$_{24}P_3 = 12,144$

How many ways could a committee of 3 students be picked to meet with the principal?

$_{24}C_3 = 2024$

1. At the souvenir shop there are 15 hats, 20 t-shirts, and 9 jerseys. Your parents tell you that they will buy you one of each. How many different ways can you pick one of each?

Use the Multiplication Counting Principle: $15 \cdot 20 \cdot 9 = 2700$

why multiply?

Because this problem really states:
How many different ways can you pick a hat AND a shirt AND a jersey.

The word AND implies multiplication

What would you do if it asked to find the number of different ways to pick a hat OR a shirt OR a jersey?

$15 + 20 + 9 = 44$

There are 25 people in a jury pool

a) A jury of 12 members must be selected from that jury pool. How many different juries are possible?

$_{25}C_{12} = 5,200,300$

b) After the jury is selected a Foreman and an Assistant Forman must be selected. How many ways can this be done?

$_{12}P_2 = 132$

You want to order a 1-topping pizza. There are 3 sizes to choose from, 4 kinds of crust to choose from, and there are 7 different toppings to choose from. How many different 1-topping pizzas are possible?

$3 \cdot 7 \cdot 4 = 84$

You want to order a 2-topping pizza. There are 3 sizes to choose from, 4 kinds of crust to choose from, and there are 7 different toppings to choose from. How many different 2-topping pizzas are possible?

$3_{\text{size}} \cdot {}_7C_2 \cdot 4_{\text{crust}} = 252$

There are 15 students in a class.

1. If there are only 15 desks, how many different seating charts could the teacher make?

$15! = {}_{15}P_{15} = 1.307 \times 10^{12}$

2. If there are 20 desks, how many different seating charts could the teacher make?

${}_{20}P_{15}$ 2.03×10^{16}

You are playing cards with a friend. You are dealt 6 cards.

1. How many ways can you arrange all 6 cards in your hand?

$6!$ or ${}_6P_6$ 720

2. When it's your turn you get to take 3 cards out of your hand and trade them in for three new cards. How many ways can you do this?

${}_6C_3 = 20$

3. How many different six card hands can be dealt?

${}_{52}C_6 = 20,358,520$

At the national convention of a political party they are going to decide who they will nominate for President and Vice-President.

There are a total of 8 candidates. How many ways can they select a President and Vice-President to run in the upcoming elections?

$_8P_2 = 56$

At a resaurant you go up to the salad bar to make a salad. There are 10 different toppings to choose from. Your plate can only hold 5 toppings. How many different salads can you make?

$_{10}C_5 = 252$

There are 18 students in the class.

a How many ways could I select 2 students to go to the office to get some more chairs?

$_{18}C_2 = 153$

b There are 4 problems to work out on the board. How many ways could I select 4 students to do these 4 problems on the board?

$_{18}P_4 = 73{,}440$

This "combination" lock has the numbers from 0 to 39.

Let's assume a "combo" to this lock is 3 different numbers.

Why is the phrase Combination Lock not a good name?

because the order DOES matter so it should be a Permutation Lock!

Find all possible "combos".

$_{40}P_3 = 59{,}280$