Multiplication Counting Principle:

multiplying the number of choices for each step

There are 5 people running a race. How many different ways can 1st through 5th place be awarded?

Factorial: $5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$

Factorial is usually used if you are arranging ALL of the available items.

There are 15 students in a class..

1. If there are only 15 desks, how many ways could I assign these 15 students to the 15 desks? $|S| = 1.3 / \times 10^{12}$

15.14.13.12....

2. If there are 20 desks, how many ways could I assign these 15 students to the 20 desks?

 $20.19.18.17....7.6.5 = 2.03 \times 10^{6}$

A password for your online credit card access must be 8 characters long.

There must be 3 numbers. 3 letters (case sensitive).

and 2 special characters from amongs: ! @ # \$ % & *

10.9.8.52.51.50.7.6

How many different passwords are possible if nothing can repeat?

000 psz, 200, 4

How many different passwords are possible if only numbers can repeat?

$$10-10-10-52-51-50-7-6$$

= $5,1569,200,000$

There are 5 people running a race.

What if prizes are only awarded to the top three finishers?

In other words, how many ways can 1st, 2nd, and 3rd places be awarded to 5 people running in the race?

Multiplication Counting Principle: $\frac{5}{2}$ $\frac{4}{2}$ $\frac{3}{2}$ $\frac{1}{2}$ $\frac{1}{2}$

Permutation: An arrangement of items when order DOES matter.

Permutation Formula: When order DOES matter

Ways to arrange n items r at a time.

$$_{n}P_{r} = \frac{n!}{(n-r)!}$$
 n= total # items r = # arranging at a time

$$_{5}P_{3} = 60$$

To use the calculator:

- Enter n first
- Press MATH
- Arrow to PRB
- Choose Option 2: _nP_r
- Press r
- ENTER

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?

$$\frac{8}{-56}$$
 or $8^{\frac{1}{2}} = 56$

You want to order a two topping pizza. If there are only 5 toppings to choose from, how many different 2 topping pizzas are possible? Toppings:

- Pepperoni
- Mushrooms
- Onions
- Green Peppers
- Canadian Bacon

Create a systematic list to help answer this question.

PM MO OG GB

PO MG

PG MB

10 p13305

You want to order a two topping pizza. If there are only 5 toppings to choose from, how many different 2 topping pizzas are possible?

Toppings:

- Pepperoni
- Mushrooms
- Onions
- Green Peppers
- Canadian Bacon

Does order matter in this situation?

NO

Combination:

Selecting a number of items when order **DOESN'T** matter.

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?

Does this situation represent a Combination or a Permuation?

Combination

Combination Formula: When order DOESN'T matter

Ways to choose n items r at a time.

$$_{n}C_{r}=\frac{n!}{r!(n-r)!}$$

n= total # items

r = # selecting at a time

To use the calculator:

- Enter n first
- Press MATH
- Arrow to PRB
- Choose Option 3: "Cr
- Enter r
- Press ENTER

Find each.

Pizza problem

 $_{10}C_5 = 252$



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 6.5.4.3.2.1 OR 6 P = 720

2. When it's your turn you must take 3 of the cards and arrange them on the table in front of you. How many ways can you do this?

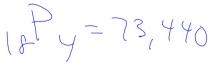
3. How many different six card hands can be dealt?

Order doesn't matter: so this isn't a permuation it's a combination

There are 18 students in the class.

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

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?



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".

$$_{40}P_{3} = 59,280$$

The lottery game Mega Millions requires you to pick 5 numbers from 1 to 56 then pick the Gold Ball which is a number from 1 to 46.

1. If you buy an Easy Pick ticket then the computer picks these numbers for you. How many different Easy Pick tickets are possible?

ways to pick 5 of 56 numbers

$$(_{56}C_5) \bullet (_{46}C_1)$$
 # ways to pick 1 of 46 numbers

179,711,536

2. What is the probability that you get a winning ticket?

175, 711, 536

= .000060 57 %

1. You have to reshelve 8 books at the library.

a. How many ways can you arrange all of these books on a shelf?

b. How many ways can you arrange 5 of these books on 8 Ps or 8.7.6.5.4 = 6720

a shelf?

2. There are 8 books from the library that you want to read but you can only check out a maximum of three books at a time. How many ways can you check out three of these books? g = 56