Your new email requires a password that must be 8 characters long with 4 letters and 4 numbers. The password is case sensitive. You can repeat letters but can't repeat number. How many different passwords are possible?

$52 \cdot 52 \cdot 52 \cdot 52 \cdot 10 \cdot 9 \cdot 8 \cdot 7$

$= 3.69 \times 10^{10}$

Multiplication Counting Principle:

The total number of outcomes is found by multiplying the number of choices each step of the way.

At an awards ceremony you need to decide where at the head table the 7 VIP's will be sitting. If the head table has only 7 seats, how many different seating arrangements are possible?

$7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 5040$

-OR-

$7! = 5040$

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

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

Suppose there are 7 VIP's but only room for 5 of them to sit at the head table. How many different seating arrangemnts are possible?

$7 \cdot 6 \cdot 5 \cdot 4 \cdot 3$

$= 2520$

Permutation Formula: When order DOES matter

Ways to arrange n items r at a time.

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

n= total # items

r = # arranging at a time

You have eight posters to hang up on a wall but the wall is only big enough for five posters at a time. How many different arrangements of posters are possible?

${}_8P_5 = 6720$

OR $8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 = 6720$

You go to a dealership to purchase a new car. For the car you want there are 10 different colors, 3 different engines, 6 different interior packages, and 4 different trim packages. How many different vehicles are possible?

$10 \cdot 3 \cdot 6 \cdot 4 = 720$

Three friends decide to have dinner together and then go shopping. Five restaurants are proposed for the dinner and four nearby stores are suggested. How many possibilities are there?

$5 \cdot 4 = 20$

Dana has to do the following during her lunch break: take lunch, mail a letter, go to the bank, buy office supplies. In how many ways can she do all these?

$4!$

$4 \cdot 3 \cdot 2 \cdot 1$

$_4P_4$

All of these result in 24

In a certain state, lisence plates consist of 3 letters then 3 digits.

How many different lisence plates are possible if letters and digits CAN repeat?

$26 \cdot 26 \cdot 26 \cdot 10 \cdot 10 \cdot 10 = 17,576,000$

How many different lisence plates are possible if letters and digits CAN'T repeat?

$26 \cdot 25 \cdot 24 \cdot 10 \cdot 9 \cdot 8$

$= 11,232,000$

How many different lisence plates are possible if letters CAN repeat but digits CAN'T repeat?

$26 \cdot 26 \cdot 26 \cdot 10 \cdot 9 \cdot 8$

$= 12,654,720$

There are 5 people running a race.

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

Multiplication Counting Principle: $5 \cdot 4 \cdot 3 = 60$

Permutation:
An arrangement of items when order DOES matter.

You are playing Scrabble. You choose 7 tiles from the pile.

1. How many ways can you arrange all 7 in front of you?

$_7P_7$ or $7!$ or $7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 5040$

2. If you can only play 3 at a time, find the number of ways you can arrange 3 of the 7 tiles on the board.

$_7P_7$ or $7 \cdot 6 \cdot 5 = 210$

There are 12 members of a club. The club needs to select a President and a Treasurer.

How many different ways can a President and a Treasurer be selected from amongst the 12 members?

$_{12}P_2$ or $12 \cdot 11 = 132$

If 4 members are running for President and 5 members are running for Treasurer, how many ways can President and Treasurer be appointed?

$4 \cdot 5 = 20$

(4: # choices for Pres; 5: # choices for Treasurer)

There are 12 members of a club. The club needs to select a President and a Treasurer.

What if there is going to be a President, Vice-President, and Treasurer? How many different ways can these positions be filled from amongst the 12 members?

$_{12}P_3$ or $12 \cdot 11 \cdot 10 = 1320$

You want to redecorate your living room and go to Art Van to look at some furniture. You decide that you are going to purchase a sofa, a recliner, a coffee table, and an end table.
In the showroom they have 12 different sofas, 7 different recliners, 6 different end tables, and 8 different coffee tables.

How many different ways can you furnish your living room?

$12 \cdot 7 \cdot 8 \cdot 6 = 4032$

(12: # sofas; 7: # Recliners; 8: # coffee tables; 6: # end Tables)

10 people entered a contest in which the top three will get a prize, either a car, a TV, or a phone. How many possible ways are there to award the prizes?

$_{10}P_3$ or $10 \cdot 9 \cdot 8 = 720$

For her literature course, Rachel has to choose one novel to study from a list of four, one poem from a list of six and one short story from a list of five.
How many different choices does Rachel have?

$\underset{\#\text{novels}}{4} \cdot \underset{\#\text{poems}}{6} \cdot \underset{\#\text{short stories}}{5} = 120$

A high school student is trying to schedule for next semester. They have to take 6 classes. There are 10 classes to choose from. How many different schedule can be created?

$_{10}P_6$ or $10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 = 151,200$