**MATH 7: HANDOUT 8**
**INTRODUCTION TO COMBINATORICS.**

## COUNTING

**Fundamental Principle of Counting (Multiplication rule).** If the first task can be performed in $m$ ways, and for each of these a second task can be performed in $n$ ways, and for each combination a third task can be performed in $k$ ways, etc. then this entire sequence of tasks can be performed in $m \cdot n \cdot k \dots$ ways.

**Permutations:** the choice of $k$ things from a set of $n$ things without repetition ("replacement") and where the **order matters**.

1. Picking first, second, and third place winners from a group. If a group has $n$ members, then this can be done in $n(n-1)(n-2)$ ways.

**Permutations of $n$ things:** The number of permutations of all $n$ different things: $n!$

1. Arranging/ordering all $n$ members of a group can be done in $n!$ ways.
2. Listing the favorite deserts in the order of choices: if there are $n$ desserts in total, there are $n!$ ways to arrange them in the order of preference.

## HOMEWORK

1. Calculate:
$$1 - 3 + 3^2 - 3^3 + 3^4 - 3^5 + \dots + 3^{20}$$
2. Calculate:
$$\frac{1}{3} + \frac{1}{3^2} + \frac{1}{3^3} + \frac{1}{3^4} + \dots + \frac{1}{3^{10}}.$$
3. Calculate an infinite sum:
$$\frac{1}{3} + \frac{1}{3^2} + \frac{1}{3^3} + \frac{1}{3^4} + \dots.$$
4. Calculate an infinite sum:
$$1 - \frac{1}{2} + \frac{1}{2^2} - \frac{1}{2^3} + \frac{1}{2^4} - \dots.$$
5. A dinner in a restaurant consists of 3 courses: appetizer, main course, and dessert. There are 5 possible appetizers, 6 main courses and 3 desserts. How many possible dinners are there?
6. How many ways are there to seat 5 students in a class that has 5 desks? if there are 10 desks?
7. How many ways are there to select first, second and third prize winner if there are 14 athletes in a competition?
8. How many ways are there to put 8 rooks on a the chessboard so that no one attacks the others?
9. A dressmaker has two display windows. The left display is for evening dresses and the one in the right window for regular day dresses. Assuming she can put 10 evening dresses in any order, and separately, 5 regular dresses in any order, how many total possibilities of arranging the two display windows are there?