PAP Geometry
Notes Permutation
and Combinations

Name_____ Per_____

- **Factorial** - is the __* product__ of the integers less than or equal to *n* where *n* is a positive integer. It is written using a __* number__ and __!__.

n! = n(n-1)(n-2)(n-3) ... (3)(2)(1)

5! = (5)(4)(3)(2)(1) = __120__ 3! = __6__

Practice with the factorial button on your calculator. Math PRB 4: !

6! = __720__ $\frac{6!}{4!}$ = __30__ $\frac{15!}{12!\ 3!}$ = __455__

- **Permutation** is an arrangement of objects where __* order__ is __important__.

* ABC is not the same as BAC

To work a permutation by hand

1. Draw enough lines to cover the scenario and then ask:
   " How many possibilities could go on each line?"
2. Multiply the numbers on the lines to determine the number of permutations.

1. How many ways can six horses finish a race?

6 5 4 3 2 1 720

2. If there are six horses in a race and all have an equal chance of finishing in any position, how many different pairs of first and second place winners are there?

6 5 30

3. How many ways can a choir of three boys and three girls be arranged if the boys must sit in the first three chairs?

3 2 1 3 2 1 36

4. Eli and Mia, along with 30 other people, sign up to audition for a talent show. Contestants are called at random to perform for the judges. What is the **probability** that Eli will be called to perform first and Mia will be called second?

32 31 992 Probability = 1/992

Day 3 Notes Permutations and Combinations

To work a permutation using a formula.

The number of permutations of *n* distinct objects taken *r* at a time is denoted by ${}_nP_r$ and given by $${}_nP_r = \frac{n!}{(n-r)!}$$

1. Five runners are scheduled to participate in a marathon. Assuming each runner has an equal chance of finishing in a given position, how many different possibilities are there for first and second place?

$${}_5P_2 = \frac{5!}{(5-2)!} = \quad 20$$

2. Brad, Shawn and John are on the base ball team. The team is being assigned numbers from 1-20. What is the **probability** that Brad will be 1, Shawn will be 2 and John will be 3?

$${}_{20}P_3 = \frac{20!}{(20-3)!} = \quad 6840 \qquad \text{Probability} = \frac{1}{6840}$$

Combination is an arrangement of objects where order is **NOT** important.

To work a combination by hand

1. Find the number of ways using lines, as if it were a permutation.
2. Divide by the factorial of the size of the group

1. At Chili's, diners select 3 out of 5 menu options for a single price. How many different combinations of the three menu options are there?

5 4 3 $\quad \frac{60}{3!} = 10$

2. A marching band is divided into squads of 8 musicians. Each squad is required to select a head and an assistant squad leader. Andy and Matthew are in one of the squads. If the positions are decided at random, what is the **probability** that Andy and Matthew are selected as leaders?

8 7 $\quad \frac{56}{2!} = 28 \qquad$ Probability = $\frac{1}{28}$

To work a combination using a formula.

To find the number of combinations of n distinct objects taken r at a time, denoted by ${}_nC_r$ use the formula: $${}_nC_r = \frac{n!}{(n-r)!r!}$$

1. You have 15 soccer trophies but only has room to display 9 of them. How many different combinations are possible?

$${}_{15}C_9 = \_\_\_\_\_ \qquad {}_{15}C_9 = \frac{15!}{(15-9)!9!} = 5005$$

2. Lisa and Ellen are managers at Hobby Lobby. Assuming that each manager has an equal chance of being selected, what is the **probability** the will be selected out of the ten managers for special training?

$${}_{10}C_2 = \frac{10!}{(10-2)!2!} = 45 \qquad \text{probability} = \frac{1}{45}$$