Precalculus
Section 9.1

Permutations and Combinations!

If you are arranging the letters A through G in the alphabet, how many different ways are there of doing this with no repetition?

A B C D E F G 7 letters

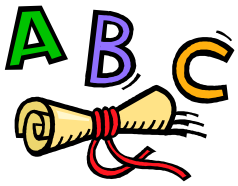
$7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

Another way of saying this is 7! .

Seven Factorial MATH → PROB → 4

From these letters, how many 3 letter words can you make not repeating any letters?

$7 \times 6 \times 5 = 210$ 7 letters total — Choosing 3



This is called a permutation .

Notation: ${}_nP_r$ order matters

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

n = # elements in set
r = # elements chosen

1. For my softball team, I have 15 players. How many different ways can I pick a pitcher, then a catcher, a shortstop and then a center fielder? (Order matters b/c it must be in this order!)

$${}_{15}P_4 = \frac{15!}{(15-4)!} = \frac{15!}{11!} = 15 \cdot 14 \cdot 13 \cdot 12 = 32,760$$

2. How many 5 letter "words" can I make from the letters in **HINSDALE**?

No repetition

$${}_8P_5 = \frac{8!}{(8-5)!} = \frac{8!}{3!} = 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 = 6720$$

3. A permutation is selected at random from the letters **MISSISSIPPI.**

a) What is different about this word? Repetition

4 I's 4 S's 2 P's

b) How many different ways are there of arranging all the letters?

$$\frac{11!}{4!4!2!} = 34,650$$

Permutations with Repetition

a, b # repetitions

$$\frac{{}_nP_r}{{}_aP_a \cdot {}_bP_b \cdots}$$

How many ways can 2 students from our class of 20 be chosen to go to the office?

$20 \cdot 19 \div 2 = 190$ order doesn't matter, so choosing Alex then Allie is same as choosing Allie then Alex.

This is called a Combination.

Notation: ${}_nC_r$

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

4. In how many different ways can you form a committee of 5 people from a group of 9 people?

NOTE: Does order matter – permutation or combination?

No - just committee - not Pres, VP, etc.!

${}_9C_5 = \frac{9!}{5!(4!)} = \frac{9 \times 8 \times 7 \times 6}{4 \times 3 \times 2 \times 1} = 126$ ways

OR $9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \div 5!$ $= n(S)$

5. A standard deck of playing cards has 52 cards. How many 5-card poker hands can be dealt from the deck?

${}_{52}C_5 = \frac{52!}{5!(47!)} = 25,989,600$

6. For the annual MathRules party, Mrs. D is buying treats! At the store, she finds 7 varieties of soda and 10 varieties of snacks. How many combinations of 3 soda options and 4 snack options are possible?

${}_7C_3 \cdot {}_{10}C_4 = 35 \cdot 210 = 7,350$

7. A standard deck has 4 suits of 13 cards each. The suits are hearts, diamonds, spades, and clubs. If 5 cards are drawn, how many different combinations of 2 hearts, 2 clubs, and 1 diamond are possible?

${}_{13}C_2 \cdot {}_{13}C_2 \cdot {}_{13}C_1 = 78 \cdot 78 \cdot 13 = 79,092$

Think about your gym lock...

Should it be called a Locker Combination? Permutation! (order matters)