Fundamental Counting Principle p. 80

Can be used to find the number of possibilities when given several groups of choices.

1. At a local restaurant, they are running a special where you can purchase a lunch combo for $5. This combo includes a soup, a salad, & drink. Here are all possible choices. How many different combinations are available?

Soups	Salads	Drinks
Chicken Noodle CN		
Wedding Soup W	Garden G	Iced Tea T
Vegetable V	Caesar C	Lemonade L
Tomato T		

Tree Diagram

or $\text{soup}_4 \cdot \text{salad}_2 \cdot \text{drinks}_2 = 16$

2. You are buying a new vehicle & need to make the following choices: body style (sedan, SUV, hatchback or truck), color (red, silver, blue, black or white) & model (GL, SS, SL). How many different combinations of cars could you buy?

$\text{Body}_4 \cdot \text{Color}_5 \cdot \text{Model}_3 = 60$ possibilities

3. The format for a California license plate is 1 digit followed by 3 letters and then 3 digits. How many possible CA license plates are there in this format?

$\#_{10} \cdot L_{26} \cdot L_{26} \cdot L_{26} \cdot \#_{10} \cdot \#_{10} \cdot \#_{10} = 175{,}760{,}000$ different plates

Note: If you have a situation where you can repeat objects then you must use the Fundamental Counting Principle. You cannot use combinations or permutations.

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Permutations p. 81

Permutations & Combinations

A **combination** is an arrangement of items in which **ORDER DOES NOT MATTER.**	A **permutation** is an arrangement of items in a particular order. Notice, **ORDER MATTERS!**

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

Remember:
- n ⟶ total
- r ⟶ want

Permutations (ORDER MATTERS)

Examples:

- 1st, 2nd & 3rd place in a 5K out of 100 runners
- Reordering the letters in the word HARRISON
- Phone number, zip code, or combination lock
- Baseball batting order
- President, VP, Secretary of out of the senior class

1. You have 8 songs in a playlist. Find the # of orders you can play all 8 songs without repeating them.

1st Song	2nd	3rd	4th	5th	6th	7th	8th	Outcomes
8 ·	7 ·	6 ·	5 ·	4 ·	3 ·	2 ·	1 =	40,320

or 8! Math PROB 4:!

The solution in this example involves the product of all the integers from *n* to one (n is the starting value). The product of all positive integers less than or equal to a number is a **factorial**. The product of counting numbers beginning at *n* & counting backward to 1 is written n! & is called ***n* factorial.**

More factorial examples:

a. 6! = 720

b. For the 8th grade field events there are five teams: Red, Orange, Blue, Green, and Yellow. Each team chooses a runner for lanes one through 5. Find the number of ways to arrange the runners.

Lane 1 2 3 4 5

5 · 4 · 3 · 2 · 1 or 5! = 120

2. How many ways can the student council of 15 members choose a president, a vice president, a secretary, and a treasurer?

President	Vice-Pres.	Secretary	Treasurer	Outcomes
15 ·	14 ·	13 ·	12 =	32,760

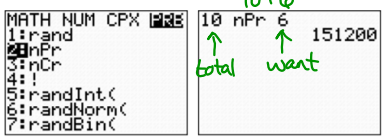
or use permutations

nPr $_{15}P_4$ (total n, want r)

calc: 15 Math: Prob 2:nPr 4

Permutation Notation: *n*P*r*

You can use your calculator to find permutations. $_{10}P_6$



Simplify each expression.

3. $_{12}P_2$ 132

4. $_{10}P_4$ 5,040

5. At a school science fair, ribbons are given for first, second, third, and fourth place. There are 20 exhibits in the fair. How many different arrangements of four winning exhibits are possible?

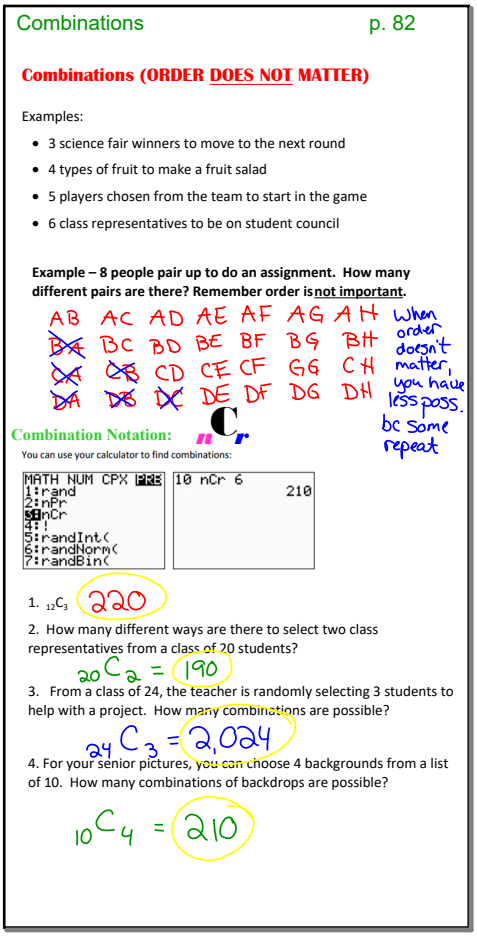
n = 20, r = 4 places $_{20}P_4$ = 116,280

6. Bugs Bunny, King Tut, Mickey Mouse and Daffy Duck are going to the movies (they are best friends). How many different ways can they sit in seats A, B, C, and D below?

$\frac{4}{A} \cdot \frac{3}{B} \cdot \frac{2}{C} \cdot \frac{1}{D}$ or 4! or $_4P_4$ = 24

7. Coach is picking a captain and co-captain from 15 seniors. How many possibilities does he have if they are all equally likely?

$_{15}P_2$ = 210



Combinations p. 82

Combinations (ORDER DOES NOT MATTER)

Examples:

- 3 science fair winners to move to the next round
- 4 types of fruit to make a fruit salad
- 5 players chosen from the team to start in the game
- 6 class representatives to be on student council

Example – 8 people pair up to do an assignment. How many different pairs are there? Remember order is not important.

AB AC AD AE AF AG AH
~~BA~~ BC BD BE BF BG BH
~~CA~~ ~~CB~~ CD CE CF CG CH
~~DA~~ ~~DB~~ ~~DC~~ DE DF DG DH

When order doesn't matter, you have less poss. bc some repeat

Combination Notation: $_nC_r$

You can use your calculator to find combinations:

MATH NUM CPX PRB
1:rand
2:nPr
3:nCr
4:!
5:randInt(
6:randNorm(
7:randBin(

10 nCr 6
210

1. $_{12}C_3$ 220

2. How many different ways are there to select two class representatives from a class of 20 students?

$_{20}C_2 = 190$

3. From a class of 24, the teacher is randomly selecting 3 students to help with a project. How many combinations are possible?

$_{24}C_3 = 2,024$

4. For your senior pictures, you can choose 4 backgrounds from a list of 10. How many combinations of backdrops are possible?

$_{10}C_4 = 210$

Clarification and Summary on Combinations and Permutations

- ***"My fruit salad is a* combination *of apples, grapes and bananas"***

  We don't care what order the fruits are in, they could also be "bananas, grapes and apples" or "grapes, apples and bananas", its the same fruit salad.

- ***"The combination to the safe is 472".***

  Now we **do** care about the order. "724" would not work, nor would "247". It has to be exactly **4-7-2**.

- If the order **doesn't** matter, then it is a **Combination**.

- If the order **does** matter, then it is a **Permutation**.

*A Permutation is an **ordered** Combination.*