Example 1- The BowerPower Breakfast Buffet features many yummy items. It has…

- Pancakes
- Waffles
- French Toast
- Muffins

- Scrambled Eggs
- Fruit
- Cereal
- Hash Browns

- Yogurt
- Doughnuts

You plan to have exactly four of these items for your meal. How many combinations could you make?

Notice that the **order of selection does not matter** for combinations. It doesn't matter what you select first or last – you will eat all of them!

Pancakes – Fruit – Cereal – Scrambled Eggs
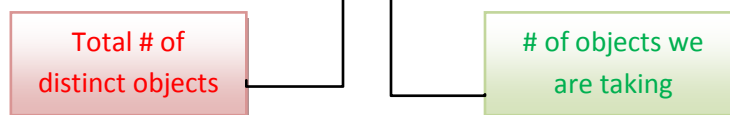
is considered to be the same combination as

Fruit – Scrambled Eggs – Pancakes – Cereal

We have 10 total items and we need to find how many combinations of 4 items are possible.

We can use the notation $_nC_r$ to help us with this.

| Total # of distinct objects | | # of objects we are taking |

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

Combinations of n objects taken r at a time

Your calculator may also have a button for **nCr**. If you have a TI-30X II S, press the **PRB** button to see choices that include **nCr**.

For our problem, we will write $_{10}C_4$. Then we can write…

$$_{10}C_4 = \frac{10!}{4!(10-4)!} = \frac{10!}{4! \cdot 6!} = \frac{(10)(9)(8)(7)(6!)}{(4)(3)(2)(1)(6!)} = \frac{5040}{24} = \boxed{\textbf{210}}$$

Or use a calculator…

If you enter **10**, followed by **nCr**, and then **4**, your calculator will give you **210**!

Combinations with "OR"

When we have more than one combination connected with "OR" we will <u>add</u> the combinations together.

Example 2- A teacher has given you a list of six books for the semester and you must read at least three of the books. How many combinations of books are possible?

You could read 3 books, 4 books, 5 books, or all 6 books! We must find the number of possible combinations for each of these possibilities and add them together.

| 3 books | 4 books | 5 books | 6 books |

$$_6C_3 \quad + \quad _6C_4 \quad + \quad _6C_5 \quad + \quad _6C_6 \quad = \quad \text{All combinations}$$

$$20 \quad + \quad 15 \quad + \quad 6 \quad + \quad 1 \quad = \quad \boxed{\textbf{42}}$$

Combinations with "AND"

When we have more than one combination connected with "AND" we will multiply the combinations together.

There are 52 cards in a standard deck of playing cards. There are four suits (clubs, diamonds, hearts, spades), each containing thirteen cards (ace, 2, 3, 4, 5, 6, 7, 8, 9, 10, jack, queen, king). Jacks, queens, and kings are also known as face cards.

Example 3- How many 7-card hands with exactly 3 hearts, 2 spades, and 2 clubs are possible?

We need 3 hearts AND 2 spades AND 2 clubs.

The hand will look like this:

There are 13 hearts in the deck – we need 3 hearts $$_{13}C_3$$	•	There are 13 spades in the deck – we need 2 spades $$_{13}C_2$$	•	There are 13 clubs in the deck – we need 3 clubs $$_{13}C_2$$

$$_{13}C_3 \bullet {_{13}C_2} \bullet {_{13}C_2} = 286 \bullet 78 \bullet 78 = \boxed{\textbf{1,740,024}}$$