

# Combinations

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Name: \_\_\_\_\_ Date: \_\_\_\_\_

**Permutations:** arrangements in which the order of the items matters.

**Combinations:** arrangements in which the order does not matter.

## Consider the following situation...

You have four distinct tiles that are each of a different colour: **R**ed, **B**lue, **W**hite, and **G**reen

1. Calculate the number of permutations if you are selecting 3 of the colours.
2. List each of these permutations (e.g. RBW)
3. How many distinct groupings are there (ignoring the order)?
4. List each of these **combinations** of three items chosen from the group of four.

## The number of combinations can be calculated as:

$$\# \text{ of combinations} = \frac{\text{number of permutations}}{\text{number of permutations of the selected objects}}$$

## Combinations:

A combination of  $n$  (**distinct**) objects taken  $r$  at a time is a selection of  $r$  of the  $n$  objects without regards to order. The total number of combinations of  $n$  objects taken  $r$  at a time is denoted by  $\binom{n}{r} = {}_n C_r$  ; read as  $n$  chose  $r$ .

## Alternate Explanation

Calculate the number of combinations of  $r$  out of  $n$  objects,  $\binom{n}{r}$ , so in order to find the number of arrangements,  $P(n, r)$ , we must arrange the  $r$  objects. There are  $r!$  Ways of doing this.

So, 
$$P(n, r) = r! \binom{n}{r}$$

$$\binom{n}{r} = \frac{P(n, r)}{r!} = \frac{n!}{(n-r)!r!}$$

## Examples:

- You have 10 books that you would like to place on your shelf. You only have space for eight of them. How many ways can you place the books on the shelf if
  - The order matters (permutations)?
  - The order does not matter (combinations)?
- Using your calculator's  ${}_n C_r$  button calculate the value of the following combinations
  - $\binom{40}{7}$
  - $\binom{30}{5}$
- There are 31 people in your data-management class. How many ways can you choose a group of 5 people to represent the class at a school wide assembly?

4. You are at Sweet Molly's and you want to buy some candy. The store is low on stock and only has 8 kinds of chocolate and 11 kinds of candies.
- a) You want to buy 9 things consisting of 4 chocolates **and** 3 candies.

Chocolates can be chosen in:

Candies can be chosen in:

Therefore,

- b) You want to buy 5 different chocolates **or** 6 different candies.

### Practice Questions:

1. A club has 25 people.
- a) In how many ways can a committee of three members be chosen?
- b) In how many ways can the offices of president, secretary, and treasurer be filled?
2. Acton High School's improve team consists of 5 boys and 5 girls. How many working groups of four people can be formed with
- a) No restrictions?
- b) four boys?

- c) Three boys and a girl?
  - d) Two boys and two girls?
  - e) A boy and three girls
  - f) Four girls?
3. Five people go out for dinner to a local restaurant. The restaurant offers a “*dinner for five*” option. The dinner lets the group chose three dishes from column A of the menu that has 14 dishes on it and two dishes from column B that has 10 dishes on it. How many different “*dinner for five*” meals could the chose?
4. How many poker hands (5 cards) are there with three aces and two kings?
5. In basketball there are 5 positions (1 centre, 2 forwards, and 2 guards). From a team of 10 players how many ways are there to fill the 5 positions if
- a) ten players can play any of the five positions?
  - b) Two players who can play centre and eight players who can play any of the other positions?
  - c) Two centres, four forwards and four others who play any of the other positions?