

Permutation: An arrangement of items in a particular order.

Example: A word is a permutation of letters. The following words have the same letters in a different order: restrain, retrains, strainer, terrains, trainers

$n!$ is pronounced n factorial. $n! = n(n - 1)(n - 2)\dots(2)(1)$. $n!$ calculates the number of different permutations in a set of n items.

Example: Four people win trophies from 1st through 4th place. In how many ways can the trophies be awarded?

$$n = 4, \text{ so } n! = 4(3)(2)(1) = 24$$

Sometimes you may want to use only part of the set. The number of permutations of n different items taken r items at a time and with no repetitions, is written ${}_n P_r$. This is read as "the number of permutations of n items taken r at a time."

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

Example: If only two of the four singers are awarded a trophy, one for 1st place and one for 2nd place, in how many different ways can the trophies be awarded.

This is the number of permutations of 4 singers taken 2 at a time.

$${}_n P_r = {}_4 P_2 = \frac{4!}{(4 - 2)!} = \frac{4!}{2!} = \frac{4(3)(2)(1)}{2(1)} = \frac{24}{2} = 12$$

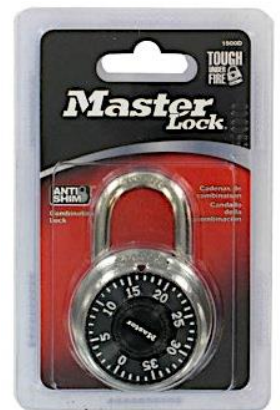
What if we considered the number of permutations of 4 singers taken 4 at a time.

$${}_n P_r = {}_4 P_4 =$$

but we know from the first example that this is equal to 24 so
 $0! =$

Find the value of the expression ${}_{80} P_4$.

- 1) Find the value of the expression ${}_7P_3$.
- 2) Suppose you want to make an arrangement of the letters in the word "SMILE" to use as a computer password. How many choices do you have?
- 3) Find the value of the expression ${}_{200}P_2$.
- 4) Ten horses are competing in a race. How many different first-second-third place finishes are possible?
- 5) Which combination lock below has more possible combinations? The lock on the left must be spun to 5 numbers from 0 through 9 in a particular order. The lock on the right must be spun to three numbers from 0 through 39 in a particular order.



- 6) Regular license plates in California begin with a digit from 1 through 9, followed by three letters, followed by three digits from 0 through 9. How many different license plates are possible?