

MATHEMATICS • CLASS 11

CHAPTER 6

Permutations and Combinations

CHAPTER NOTES



FUNDAMENTAL PRINCIPLE OF COUNTING

The multiplication principle counts choices made one after another.
If the first step has one set of choices and each choice is followed by the same number of choices at the next step, multiply the numbers of choices.

Two steps: $m \times n$ ways

Three steps: $m \times n \times p$ ways

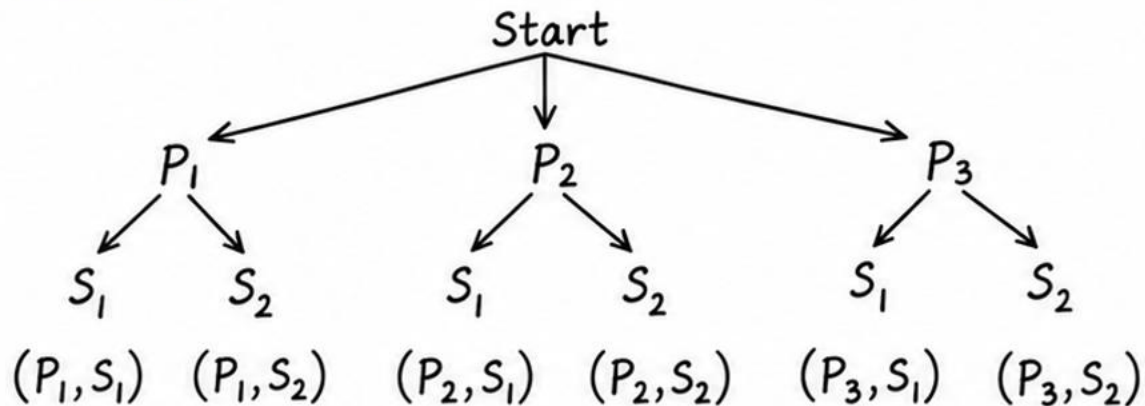
The same idea works for any finite number of steps.

Pants and shirts

Mohan chooses one pant and one shirt.

Pants = 3; shirts = 2

Total pairs = $3 \times 2 = 6$



School items

Sabnam chooses one bag, one tiffin box and one bottle.

Bags = 2; tiffin boxes = 3; bottles = 2

Total choices = $2 \times 3 \times 2 = 12$

WORDS FROM ROSE

Use all the letters of ROSE to form four-letter words. A word need not have a meaning.

Without repetition

Every letter is used once. After choosing a letter, there is one fewer letter available.

Slot choices:

First: 4

Second: 3

Third: 2

Fourth: 1

Number of words:

$$4 \times 3 \times 2 \times 1 = 24$$

With repetition

A letter may be used again. Every place still has the same number of choices.

Slot choices:

First: 4

Second: 4

Third: 4

Fourth: 4

Number of words:

$$4 \times 4 \times 4 \times 4 = 4^4 = 256$$

The important difference is whether a chosen letter remains available.

SIGNALS MADE WITH FLAGS

A signal is made by putting different flags one below another. Changing their order gives a different signal. No flag is repeated.

Two flags from four

Choose the upper flag first, then the lower flag.

$$\text{Number of signals} = 4 \times 3 = 12$$

At least two flags from five

Count each possible signal length separately.

$$\text{Using 2 flags: } 5 \times 4 = 20$$

$$\text{Using 3 flags: } 5 \times 4 \times 3 = 60$$

$$\text{Using 4 flags: } 5 \times 4 \times 3 \times 2 = 120$$

$$\text{Using 5 flags: } 5 \times 4 \times 3 \times 2 \times 1 = 120$$

$$\text{Total} = 20 + 60 + 120 + 120 = 320$$

A signal has only one length, so these cases do not overlap. Add the case counts.

TWO-DIGIT EVEN NUMBERS

Form two-digit even numbers from the given digits. Repetition is allowed.

Available digits: 1, 2, 3, 4, 5

Start with the restricted place

An even number must have an even units digit.
Choose that digit first.

Units digit: 2 or 4 $\rightarrow$ 2 choices

Tens digit: 1, 2, 3, 4 or 5 $\rightarrow$ 5 choices

Number of even numbers = $5 \times 2 = 10$

Check the count

12, 14, 22, 24, 32, 34, 42, 44, 52, 54

Repeating a digit is allowed, so the double-digit entries in the list are valid.



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