



Factorials

The **factorial** of a number is **the product of all the whole numbers (except zero) that are less than or equal to that number.**

For example, to find the factorial of 7 you would multiply together all the whole numbers, except zero, that are less than or equal to 7.

$$7! = 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 5,040$$

The factorial of a number is shown by putting an exclamation point after that number. So, 7! is a way of writing “the factorial of 7” (or “7 factorial”).

Here are some factorials:

$$1! = 1 = 1$$

$$2! = 2 \times 1 = 2$$

$$3! = 3 \times 2 \times 1 = 6$$

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

$$5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$$

$$6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$$

$$7! = 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 5,040$$

Factorials on a TI-83 or 84 graphing calculator:

1. Type in the number that you are taking the factorial of
2. Press the **MATH** key
3. Press the *right arrow* key 3 times, **PRB** should be highlighted on the calculator screen.
4. Press the *down arrow* key 3 times, Option **4: !** should be highlighted on the calculator screen
5. Press the **ENTER** key twice and the value of your factorial will be calculated.

Factorials are useful because they can **show how many different ways there are to order or arrange a set** of things.

For example, if there are 5 books on a shelf, how many different ways can the books be ordered or arranged on the shelf? To solve, find the factorial of 5.

$$5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$$

This shows that the books can be arranged 120 different ways.

Note : Mathematicians have decided that **the factorial of zero, or 0!, is 1.**

Why?

A set of nothing, an empty set, can only be arranged in just **one** way — as nothing — an empty set.