Differential equations
Computational practicum

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Variant 17

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To solve the problem, it was decided to use the **Python** language.

For correct work of the program, it is necessary to connect the library matplotlib for python.

The program has three main functions:

- **func(x, y)**. This function takes two variabes x and y, and returns value of given function (variant 17)

- **isnan(num)**. Since when finding the values of functions, the values can be so large that the programming language simply replaces them with NaN, it was decided to replace them with the largest number that the language can recognize. So, this function checks whether to replace or not.

- **construction(xx0, yy0, hh, xx)**. Main function, which construct our graphs, where xx0 is x0, yy0 is y0, hh is step and xx is X.

Let's take a closer look at the method construction.
Points found by the approximation method are written to arrays xdots and ydots. Points from initial value problem solution are written to arrays xdots1 and ydots1.
To make it easier to navigate in the code, before each block of code written commentary, talking about the name of the method, which is described in this block.
After performing any method, the arrays are filled, after that, a graphs of approximation and errors are drawn at these points and then the arrays are immediately cleared in order to write new values to the arrays.

A little bit about graph.
On a given segment, at certain values of X, the Y values are very large, so it was decided to limit the graph along the Y axis in order to see the beginning of the graph.

About given function.
You can see, that IVP graph is different than approximations. This happened because the function has a points of discontinuity (**x ~ -4.5**), after which the approximation methods work incorrectly.

Solution of given differential equation is $y(x) = \frac{1}{c_1 - x} + e^x$

Where c1 is $\frac{1}{2 - \frac{1}{e^5}} - 5$

Which is equal to $-4.49830981907548450789563598003704187677584752312333451197\ldots$

Actually with the same value of **x** there point of discontinuity