Usage of linear equations and systems

Linear equations can be used for problem solving in a large number of situations.
The goal is to present a problem in a linear equation form whose solution will, at the same time, be the solution of the given problem.
The process is performed based on the following steps:

1. Problem analysis is done to determine what the given problem task is and what is required
2. Selection of the unknowns (what exactly is the unknown quantity in the task)
3. Creating the equation based on the task conditions and unknown defined variables
4. Solving the equation
5. Checking the solution, whether the solution obtained meets the requirements of the task

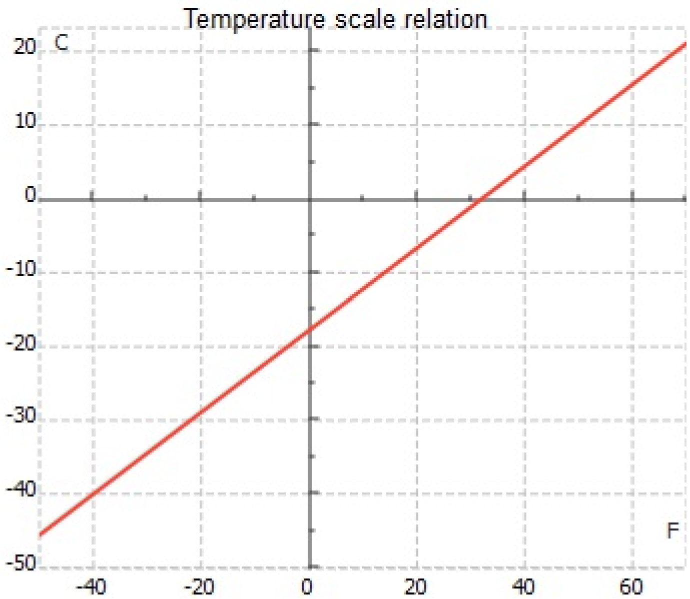
Temperature scales

One of the examples of linear equations and their linear relationship in general is the relation between two temperature scales, the Celsius scale and the Fahrenheit temperature scale. Their relation can be presented with the linear formula

$$\text{Celsius} = \frac{5}{9} \cdot (\text{Fahrenheit} - 32) \quad (1)$$

We can present this relation on a 2D graph

$$a := \text{curve2d}\left(\frac{5}{9} \cdot (x-32), -50, 70, 200\right)$$



From the graph we can see that when the Celsius scale is at 0, the Fahrenheit scale is at 32 degrees. On the other hand, when the Fahrenheit scale is at 0 degree, the Celsius scale is at approximately -17.77 degrees. These values can easily be calculated if we replace the Celsius or Fahrenheit in the formula (1). This is just one of the many examples of linear equations. Their graphs are always composed of straight lines.

Solving a Mixture Problem

If we have a 35% and a 60% acid solution, how much of each solution should be used to form 350 mL of a 45% acid solution?

The unknowns in this case are the amounts of the 35% and 60% solutions to be used in forming the mixture. We will use the variable x to be the amount of the 35% solution and y as the amount of the 60% solution.
To form our equations, we have to consider the two relationships: the total amounts combined and the amounts of acid combined. The equations are

$$x + y = 350$$

Total amount combined.

$$0.35 \cdot x + 0.6 \cdot y = 0.45$$

Amount of acid combined.

If we multiply the second equation by 100 to clear it from decimals the system will transform to

$$x + y = 350$$

Total amount combined.

$$35 \cdot x + 60 \cdot y = 45$$

Amount of acid combined.

If we put these equations in the MatDeck linsolvesys function, we have the below values as a result.

$$\text{linsolvesys}\left(\begin{bmatrix} x + y == 350 \\ 35 \cdot x + 60 \cdot y == 45 \end{bmatrix}, \begin{bmatrix} x \\ y \end{bmatrix}\right) = \begin{bmatrix} 838.2 \\ -488.2 \end{bmatrix}$$

To check the result, return the calculated x and y values to the equations from which we started with. In real life scenarios, we would've had to create the mixture of the calculated amount of acids and measure the acidity to check if it is was as specified.