# Examples of functions in real life	Season	01
	Episode	07
	Time frame	1 period

Objectives :
- Discover the concept of function.
- See that functions appear everywhere in physical phenomenons and human activities.

Materials :
- *Four different texts about a practical example of function.*
- *Slideshow with the four formulas and graphs.*

1 – Team work on one document — 25 mins

Working in teams of four or five people, students work on a text about a practical example of function. Each team has to prepare a presentation showing
- in what field the function appears ;
- what it used for ;
- the formula of the function ;
- the graph of the function, with precise information on the axes.

2 – Oral presentations — 30 mins

Each team goes to the board to present their function to the class.

Examples of functions in real life	Season	01
	Episode	07
	Document	Document 1

Below is a text introducing a practical example of a *function*. Read the text carefully and then, working as a team, prepare a presentation to explain to the class
- in what field the function appears ;
- what it is used for ;
- the formula of the function ;
- how the graph of the function is drawn.

You may use your calculator to try out a few computations.

Any sound is a vibration, a series of variations of pressure, emitted by a source, transmitted in the air and received by our ear. Musical sounds are periodic vibrations, whereas noise is made of random vibrations.

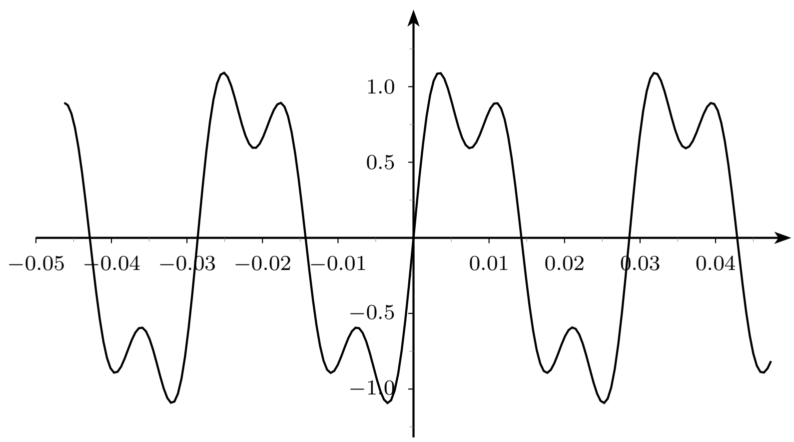
A pure sound is a simple, sinusoidal vibration. The number of actual vibrations during one second is called the *frequency*. The greater the frequency, the higher the sound. For example, the A (la) above middle C (do) on a piano its usually set to a frequency of 440 Hz, which means 440 vibrations in one second.

Of all musical instruments, only synthesisers can produce pure sounds. Other instruments, such as the guitar or the violin, produce a mix of different pure sounds : a complex sound.

Let's look more closely at the example of the flute. When playing the note A with a 220 Hz frequency, a flute emits in fact three simultaneous pure sound : the main one with a frequency of 220 Hz, a second one, more difficult to hear, with a frequency of 440 Hz and the third one, easier to hear than the second but still behind the main sound, a frequency of 660Hz. The resulting sound can be expressed as a function s, where the variations of pressure $s(t)$ are given as a function of the time t in seconds :

$$s(t) = 1\sin(220t) + 0.1\sin(440t) + 0.4\sin(660t).$$

The graph of this function is shown below :



Examples of functions in real life	Season	01
	Episode	07
	Document	Document 2

Below is a text introducing a practical example of a *function*. Read the text carefully and then, working as a team, prepare a presentation to explain to the class

- in what field the function appears ;
- what it is used for ;
- the formula of the function ;
- how the graph of the function is drawn.

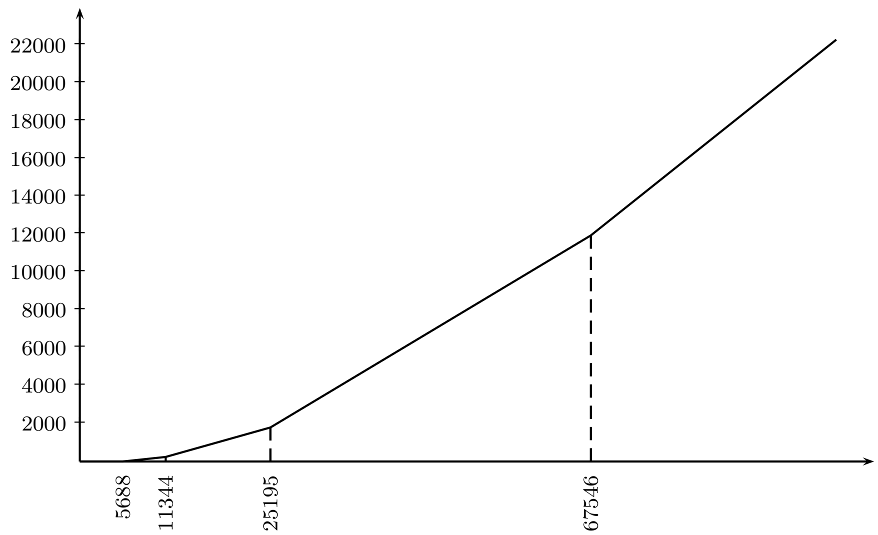
You may use your calculator to try out a few computations.

An *income tax* is a tax levied by the government over the income of individuals, organisations or companies. In France, the income tax paid by each family depends on the family quotient, which is equal to the net income of the family (the total income minor various deductions) divided by the number of people in the family (children being counted as 0.5 most of the time).

For a single person, the family quotient is therefore equal to the net income. The rule to compute the income tax T in this case is given by the government as the following formula, where the net income is I :

$$T(I) = \begin{cases} 0 & \text{if } I \leqslant 5687 \\ I \times 0.055 - 312.79 & \text{if } 5688 \leqslant I \leqslant 11344 \\ I \times 0.14 - 1277.03 & \text{if } 11345 \leqslant I \leqslant 25195 \\ I \times 0.30 - 5308.23 & \text{if } 25196 \leqslant I \leqslant 67546 \\ I \times 0.40 - 12062.83 & \text{if } I > 67546 \end{cases}$$

This function can be graphed as shown below :



Examples of functions in real life	Season	01
	Episode	07
	Document	Document 3

Below is a text introducing a practical example of a *function*. Read the text carefully and then, working as a team, prepare a presentation to explain to the class
- in what field the function appears ;
- what it is used for ;
- the formula of the function ;
- how the graph of the function is drawn.

You may use your calculator to try out a few computations.

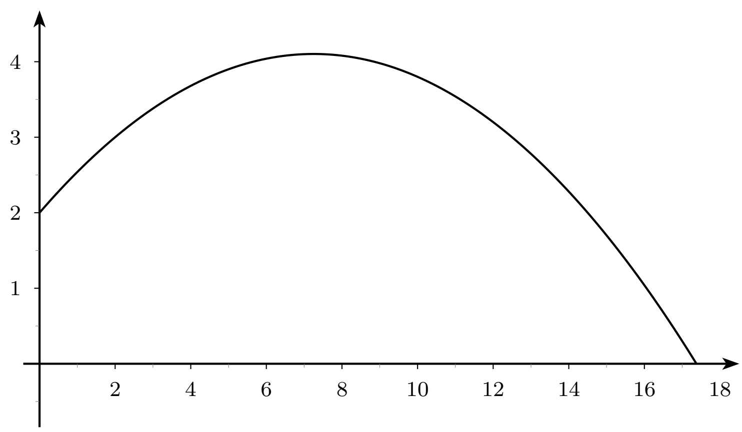
A volleyball is thrown into the air by a player. During its *trajectory*, before it reaches the ground or another player, the position of a volleyball can described by three coordinates, the abscissa x, the ordinate y and the altitude z They all depend on the time t elapsed since the moment the ball was thrown.

To simplify the problem, we neglect air friction, and we also suppose that the ball doesn't move sideways, so that the coordinate y is constant, always equal to 0.

In these conditions, the trajectory depends only on three parameters : the initial speed of the ball, which is related to the strength and technique of the player throwing it, the initial height of the ball, and the angle between the ground and the direction of the ball when it is thrown. Suppose that the initial speed is $v_0 = 12$ meters per second, the initial height is 2 meters and the angle is $\alpha = 30°$. Then, the altitude z of the ball as a function of the abscissa x, is given by the formula

$$z(x) = -0.04x^2 + 0.58x + 2.$$

The graph of this function, shown below, gives a graphical representation of the trajectory, the ground being the x-axis.



Examples of functions in real life

Season	01
Episode	07
Document	Document 4

Below is a text introducing a practical example of a *function*. Read the text carefully and then, working as a team, prepare a presentation to explain to the class

- in what field the function appears ;
- what it is used for ;
- the formula of the function ;
- how the graph of the function is drawn.

You may use your calculator to try out a few computations.

Radioactive decay is the process in which an unstable atomic nucleus loses energy by emitting ionising particles and radiation. This decay, or loss of energy, results in an atom of one type, called the parent nuclide, transforming to an atom of a different type, called the daughter nuclide. For example : a lead-214 atom (the "parent") emits radiation and transforms to a bismuth-214 atom (the "daughter"). This is a random process on the atomic level, in that it is impossible to predict when a given atom will decay, but given a large number of similar atoms, the decay rate, on average, is predictable.
The *half-life* of a radioactive nuclide is the time it takes for half the quantity to transform. For the lead-214 atom, it's approximately 27 minutes, or 1620 seconds. This means that if at one moment we have 1kg of lead-214, then 27 minutes later there will only be 500g left, the other 500g having decayed. Another 27 minutes later, only 25g will be left.
The number N of atoms of lead-214 therefore depends on the time t since it first appeared (for example when it's generated by another radioactive substance, such as the polonium-218). If the initial weight of lead-214 is 1kg, then the weight after t seconds is precisely given by the formula

$$N(t) = 2^{-\frac{t}{1620}}.$$

The graph of this function is given below.