# "MATH FOR A SCARED CAPTAIN"

It was a boring day, in an indefinite place in the middle of the ocean. The Nautilus II submarine was at a depth of 50 metres doing surveillance works. It had to keep an eye on a wreck found there, to avoid thieves of archaeological remains from looting it.
On board the submarine were Captain Julius McRoy and sailor Johan Andrews. The latter was a very curious young man who was fond of mathematics. The topics of conversation between the two men were always about mathematics.

Johan: "Captain, I'd like to know how many square meters of steel it took to build this submarine."

Captain: "Sailor, you need to know the shape of the submarine. It is made up of a cylinder 107 metres high, which represents the length of the submarine, and a diameter of 12 metres, which represents the beam of the submarine. In addition, each base has a hemisphere. This is, more or less, the shape of the submarine."

Sailor Johan began to calculate the total area of the submarine and said: "I have it, it took approximately .....square meters of steel."

Captain: "Do you want to keep playing calculating? The submarine is made of rectangular steel sheets that are 1.5 metres long by 0.75 metres wide. How many sheets did it take to build it?"

Johan: "How easy! I calculate the area of a sheet. This area is ..... square meters. Therefore, approximately, ..... sheets were needed to build it."

Suddenly the submarine's engine stopped. The two men tried to fix it for hours, but it was impossible. In addition, there had been a huge hole in the hull of the submarine, where the water was pouring in. Faced with this situation, the two men decided to abandon the submarine. To do this, they took an oxygen bottle each and diving would try to reach the surface.

Captain: "Johan, use your brain and tell me what is the autonomy of an oxygen bottle, that is, how long do we have oxygen for?"

Johan: "Captain, on the label of the bottle it says that it has a volume of 10 litres of oxygen and a pressure of 150 bars, therefore, knowing that the capacity is the volume times the pressure, the capacity of the bottle is ... ..... litres. Assuming that the average consumption is 20 litres per minute, we have an autonomy of ..... minutes."

Captain: "Ok sailor. We need to know how long it will take to reach the surface. I remind you that we are 50 metres deep and that the ascent in diving must be done following safety rules."

Johan: "What are those safety rules, Captain?"

Captain: "Take note sailor. Average ascent speed is 5 metres per minute for the first 40 metres ascent and 2 metres per minute for the last 10 metres ascent to avoid lung decompression. We also have to make stops of 1 minute every 5 metres of height."

Johan: "Understood, captain. I will draw a time-distance graph to see how long it will take to reach the surface and thus know if we will have enough oxygen. I hope you understand the graph."

Johan: "Finished, captain. We will take ..... minutes to reach the surface. Don't worry, we will have more than enough oxygen."

Captain McRoy became nervous and asked the sailor: "Who will save us when we reach the surface or will we die in the middle of the sea?"

Johan: "Captain, you are a man of little faith. I have seen on the submarine's radar that there is a sailboat 750 metres to the right of the point where we will touch the surface. I'll bring a firecracker and let's pray that the ship's crew will hear it explode."

Captain: "My God, sailor, I have something to confess to you. I do not know how to swim."

Johan: "Calm sir. The trajectory of the firecracker is a parabola whose function is $f(x) = -\frac{6}{125}x^2 + \frac{12}{5}x$. Therefore, the highest point where the firecracker will explode is the point whose coordinates are (  ,  )"

Johan: "That is, the firecracker will explode …… metres from us, on the straight-line that joins us with the sailboat and at ……. metres high. See the graph I have drawn."

Captain: "How long will it take the crew of the sailboat to hear the explosion?"

Johan: "I need the distance from the explosion site to the sailboat. I will use the Pythagoras' theorem."

Johan: "The distance is approximately ..... metres, and considering that the speed of sound is 344 metres per second, the sailboat will hear the explosion at ..... seconds."

Captain: "My God, I don't know if I'll stay afloat. Please, tell me how the sailboat will see us and how long it will take to help us."

Johan: "When we reach the surface I will turn on a flare so that they can see us, and assuming that the sailboat is stopped, that it is moving with a uniformly accelerated rectilinear movement and with an acceleration of 0.4 meters per second squared, I calculate that it will take to reach up to us, approximately, about ..... seconds."

Johan: "Captain, will you be able to endure this time afloat?"

Captain: "I think so."

Johan: "Well let's go there."

Captain Julius McRoy and sailor Johan Andrews exited through a scuttle of the submarine and everything happened as Johan had calculated, thanks to his curiosity to know the wonderful world of mathematics.