SPACE PROBE K7803Y	Start of the radio reception from K7803Y : 4h36min22s

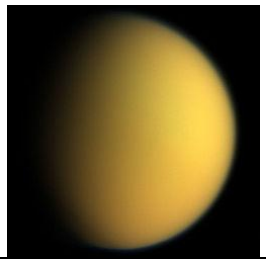
SPACE probe K7803Y …. Gravity monitoring procedure Start of the radio transmission of the data : 3h15min00s	
Measure in mN	Test mass in g
60	20
80	40
84	60
120	80
150	100
204	120
189	140

Space probe K7803Y …. Drill core sampling of the ground Start of the radio transmission of the data: 3h15min10s	
Core sampling	Diameter 2,0 cm – height 5,0 cm
Weight	19,4 mN

Scientists sent a lot of space probes all over the solar system. Some of them landed on planets, others on moons, even on a comet !

But where is the K7803Y probe ???

Here are some possibilities…

	Titan	Mars	Lune	Eros
				
Distance from Earth	9,76414 A.U	2,25067 A.U	406257 km	50.10^6 km
gravity	1,35 N/kg	3,71 N/kg	1,62 N/kg	5,9 mN/kg
Ground matter density	Ice 0,9 g/cm3	Basalt 2,70 à 3,24 g/cm3	Basalt 2,70 à 3,24 g/cm3	Chondrite 3,4 à 3,9 g/cm3

Graph Vocabulary :	**Diagram vocabulary :**	**Maths vocabulary :**
Data Table To sketch a graph Equation Linear fit Linear function Slope of x-axis y-axis	To draw A drawing To label A label To color Colored in	Mathematical formula Linear function Equation Value … is equal to… Minus (-) Divided by Multiplied by Cylinder Surface area of … Volume Pi (π) Height of … Gram per cube meter Square meter 10^{A} ….. ten to the A A^2 …. A square
Physics vocabulary : Weight Mass Gravity acceleration Velocity Density distance travel time surface Earth Sampling system of matter Drill core Electromagnetic wave Speed of light	**Information**: A.U : astronomical unit : distance from Earth to Sun ($1{,}5.10^{11}$m)	

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Level : Tenth grade in France (15-16 years old)
Main content : **mass and weight** – connected content: (density) – velocity – li
Activity : problem solving
Skills : **Analyse – Using knowledge from the lesson - Communication**
Scientific background : Video to be seen: mass versus weight (Erasmus SIMPLE website)
Author : FRANCE
Created in : 2018
Estimated lenght : 2h + record of the video at home

Material :

- Mobile phone (BYOD)
- Excel (or paper to draw a graph)
- Pencils/paper sheets
- English boxtool

Scientific background :

- Homework : video weight versus mass
- Speed of electromagnetic waves
- Velocity formula ; density formula
- Conversion unit (time ; A.U)

workshop:

Students work by group of four. Problem must be solved before the end of the lesson. Each member of the ground returns home in charge of a piece of work.

Pieces of work :

introduction : presentation of the problem to be solved, the data sent by the probe, and the places where the probe may be .

First data : present the data, present the formula to be used, explain the exploitation of the data and prensent the result

Second data : same work

Conclusion : summarise the results and conclude. Give more information about the body where the probe landed on

Teacher's comment :

Main knowledge is about weight/mass and graph interpretation.

About the second data, students can choose to use either density formula or velocity formula depending on their own scientific background.

Answers :

1/ Excel spreadsheet :

W = m.g. (teaching video) → draw of the graph using W and m data → slope of the linear function → g = 1,4N/kg → the probe may be on Titan.

2/ Use of :

- density: density = m/V → m= W/g = 15,4.10^{-3}kg being 15,6g and V = Pi.radius² . h = 15,7cm3 → density = 1,0g/cm3 → the core sample density is similar as ice density
- distance = velocity. Time → transmission time calculation : 1h21min22s = 4882s and radio is an electromagnetic wave, its speed is equal to the speed of light V= 3,0.10^{8} m/s → d = V.time = 1,46.10^{12} m that is to say : 9,8 A.U → the probe location is at the same distance from Earth than Titan.

Video report structure (example) :

1/ Introduction :

Hello, here is the problem to be fixed : a space probe, code name K78038, lost inside the solar system, sent us data. We must find out the probe location.

This video explains how we analysed of the data, and solve the problem.

2/ Thanks to the data « **Gravity monitoring procedure »** we can draw a graph with m on the x-axis and W on the y-axis. We can notice a linear function fits good to represent the relation between W and m.

We also know the mathematical formula : W = m.g.

Using both the graph and the formula, we can deduce that the slope of the linear function represents g (gravity acceleration). We found out g is equal to 1,4 N/kg, which is really close to Titan's gravity acceleration. We can set the hypothesis the probe landed on Titan .

To confirm this hypothesis we can use either the density or the time data….

Thanks to the formula…… we obtain the density of the sample core is equal to 0,9 g/cm3 / (using the second data we obtain the probe is 9,8A.U far away from the Earth.

We can conclude that the **Space probe K7803Y** certainly sent us information from Titan.

Where is Titan, and what does its surface look like ?

Titan is the Saturn's largest moon, and it is the second largest moon in our solar system, second only to Jupiter's Ganymede. On Titan it is so cold (-179 degrees Celsius) that water plays the role of rock and lava, and flowing methane carves river channels and fills great lakes with liquid natural gas. Cassini spacecraft carried the European-built Huygens probe, which parachuted through Titan's atmosphere in 2005 to make the first landing on a body in the outer solar system.