2021-2022

namazu contest

Episode 4 – Questions issued on 31/03/2022; answers due on or before the 15/06/2022 to namazu@geoazur.unice.fr

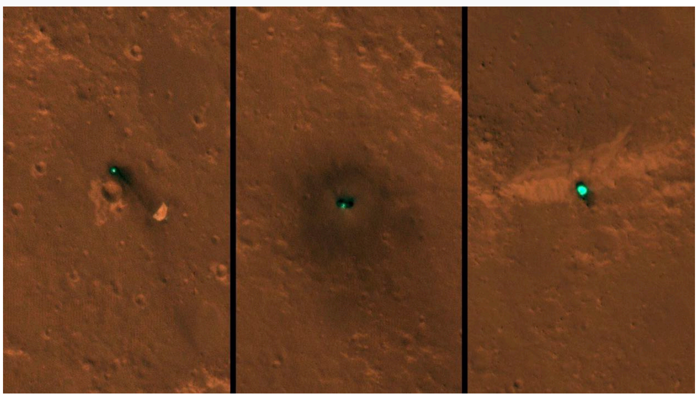
Part I – Research on Mars…

To end this school year, the questions of part I will be dedicated to InSight but also to the other Martian missions.

Q1. By the way, why is Mars called "Mars"?
- Because it is the only planet visible in the month of March in the Northern Hemisphere
- Because the first telescope observation of the planet was made in March 1610 by Galileo
- In reference to the Roman god of war and the color of blood that recalls the color of its surface
- In reference to the small village of Mars, in Ardèche (France), where the Hubert Reeves astronomical observatory is located

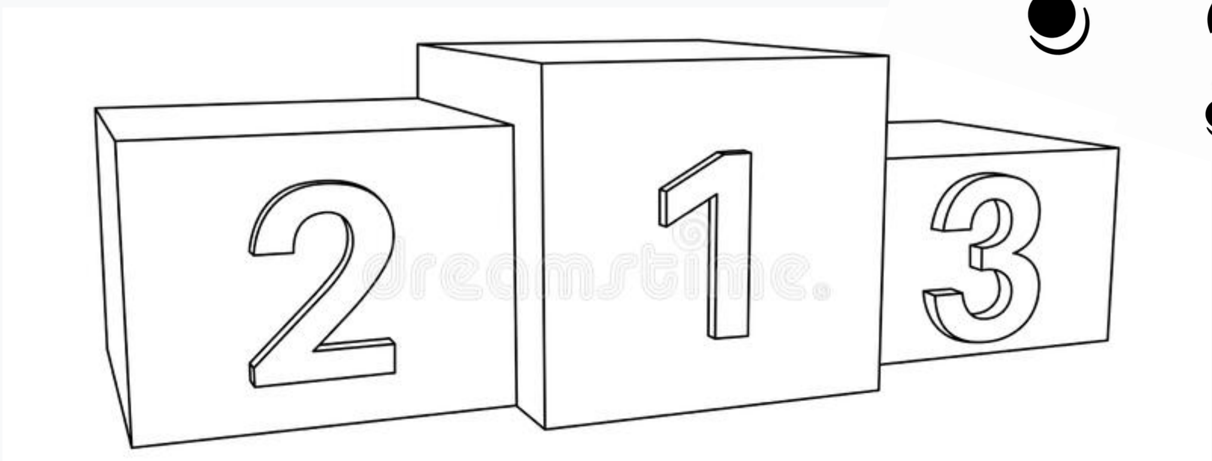
Q2. The Mars Express (ESA) mission revealed:
- The presence of polar auroras
- The presence of an underground water lake
- The presence of Martian earthquakes
- The presence of life

Q3: The Mars Reconnaissance Orbiter (NASA) mission succeeded in photographing the Martian surface using its HiRISE camera. What is his resolution?
- 3cm
- 30cm
- 3m
- 3km



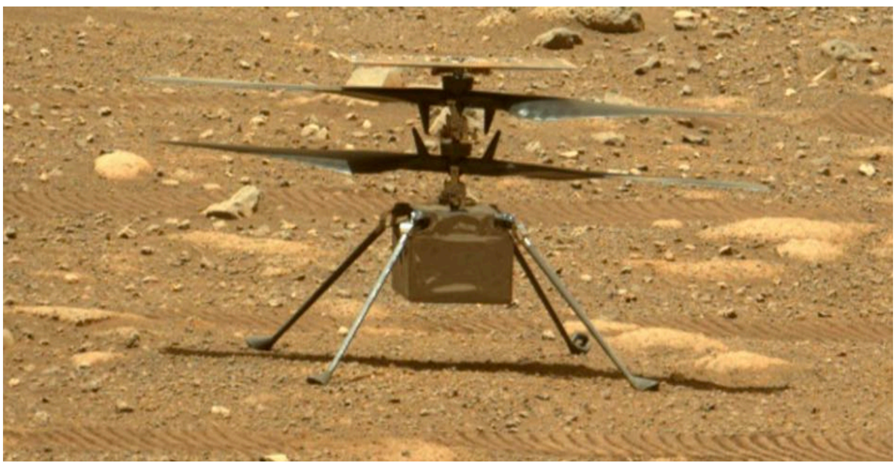
InSight seen by HiRISE, December 2018

Q4. If the Mars rovers: Curiosity, Perseverance and Tianwen-1 decided today to race over 100m, what would the podium be?
- 1. Curiosity, 2. Tiawen-1, 3. Perseverance
- 1. Tianwen-1, 2. Perseverance, 3. Curiosity
- 1. Tianwen-1, 2. Curiosity, 3. Perseverance
- 1. Perseverance, 2. Tianwen-1, 3. Curiosity

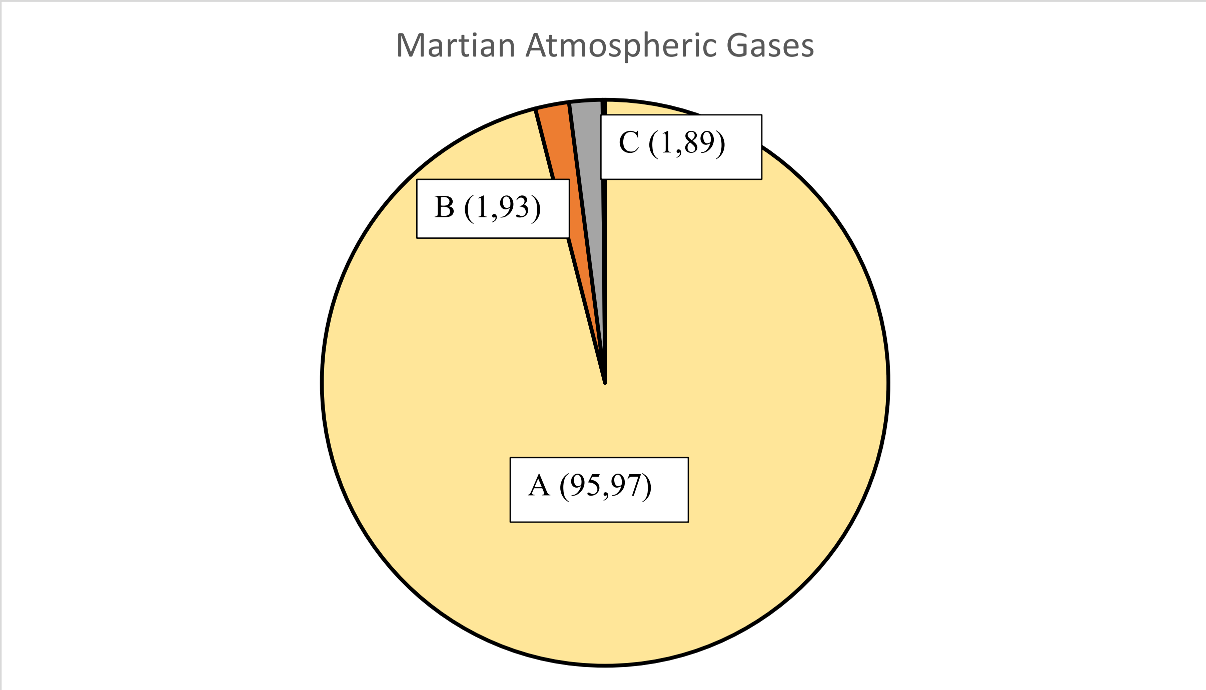


Q5. NASA engineers have decided to remove the maximum altitude of 15 meters from the Ingenuity helicopter for the Mars2020 mission. It will now be able to fly higher in the Martian atmosphere. What is the reason for this decision?

- Avoid touching the sand dunes and avoid crashing
- Take more impressive photos
- Fly faster and farther
- The reasons are kept secret defense



Q6. Many missions have succeeded in clarifying the Martian atmosphere. Here is a diagram specifying the gases present



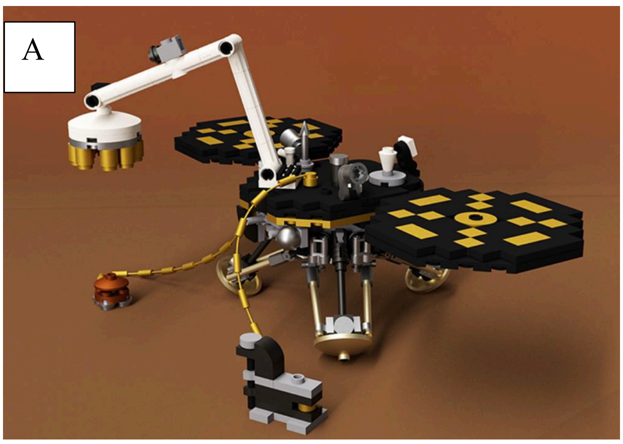
What are these gases?

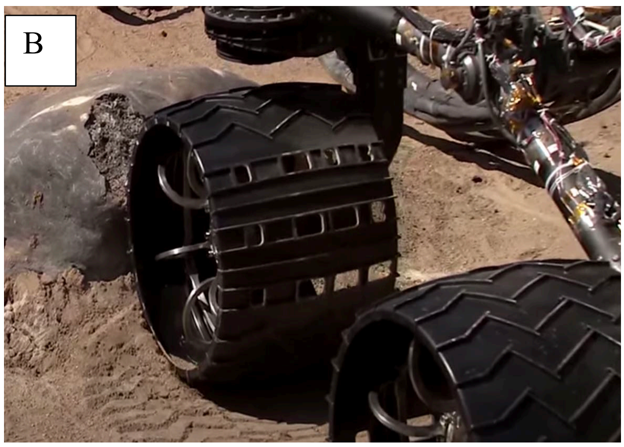
A : ______________________

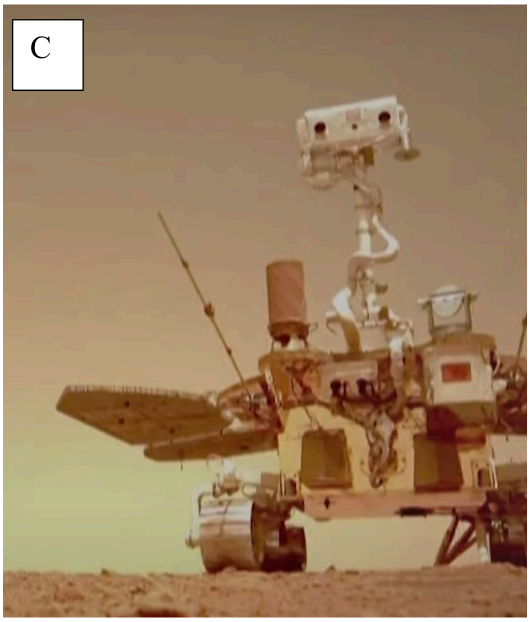
B: ______________________

C : ______________________

Q7. Identify Martian missions, using these images.







A : ________________________
B: ________________________
C : ________________________
D: ________________________

Q8. On the recordings of the SEIS seismometers, there is parasitic seismic noise called glitches. In order to reduce the amplitude and frequency of these phenomena which scramble the recordings, what was the idea of the InSight SEIS team?

- Bury the cable connecting SEIS to the lander
- Restart InSight's on-board computer
- Change the place of the seismometer
- Stop recordings during periods of glitches

Help: https://www.youtube.com/watch?v=dzv5WwCPQ84&t=146s

Part II – Souvenir: InSight's one-way trip to Mars

Proposed by Cécile Savaresse – International School of Valbonne (France)

On May 5, 2018, the ATLAS V 401 rocket took off from the Vandenberg base (West Coast of the United States in California). This rocket served as a launcher for the lander of the INSIGHT mission. Arrival of the lander on Mars scheduled for November 26, 2018 after 6 months of travel. **SEE document 1.**
The INSIGHT mission must reveal the secrets of Mars' subsoil thanks to the deployment on its surface of a geophysical station made up of various instruments including the first Martian seismometer SEIS.

Your mission will be to describe the movement followed by the rocket and then the Insight lander by answering the following problem:
Problem: How fast is the Insight lander moving towards Mars and along what trajectory?

STEP 1: describe the trajectory of the rocket then of the lander

Material: Launch VIDEO: https://www.youtube.com/watch?v=m1W5kI-tf_o
Document sheet

Q1. Using information from the Insight launch video and Handouts 2 and 3, describe the trajectory followed by the rocket first, then by the lander once it separates from the rocket.

STEP 2: calculate the average speed of the lander to Mars, determine different phases during the trip

Q2. Using the data and help below, calculate the average speed in km/h of the lander during its journey to Mars.

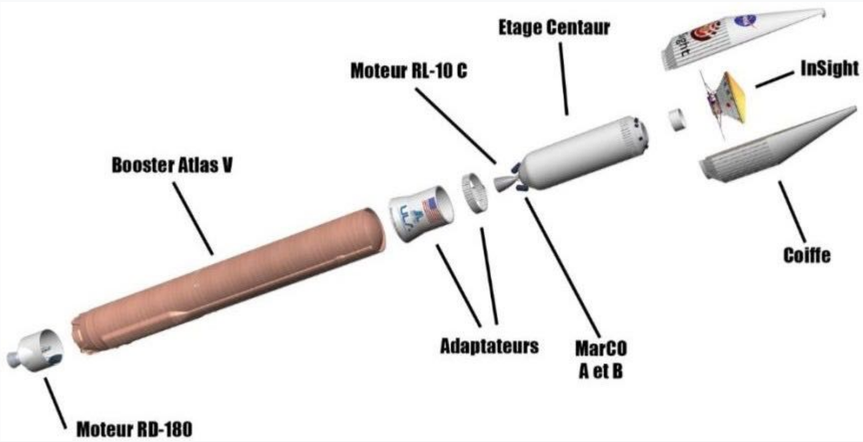
Data:
At the time of launch on May 05, 2018, the Earth-Mars distance was 121 million kilometers. However, due to its trajectory, the InSight probe will have to travel 485 million kilometers in 205 days before reaching its destination, the red planet, on November 26, 2018. According to the site https://www.seis-insight.eu /Fr/

In reality, the speed of the lander is not constant during its journey. In particular, there is an acceleration phase at the start which makes it possible to launch INSIGHT into the orbit which will take it to Mars. The speed of the lander then decreases slightly and then remains generally constant until the arrival near Mars.
We are now interested in the evolution of the speed of the lander during the landing phase on Mars.

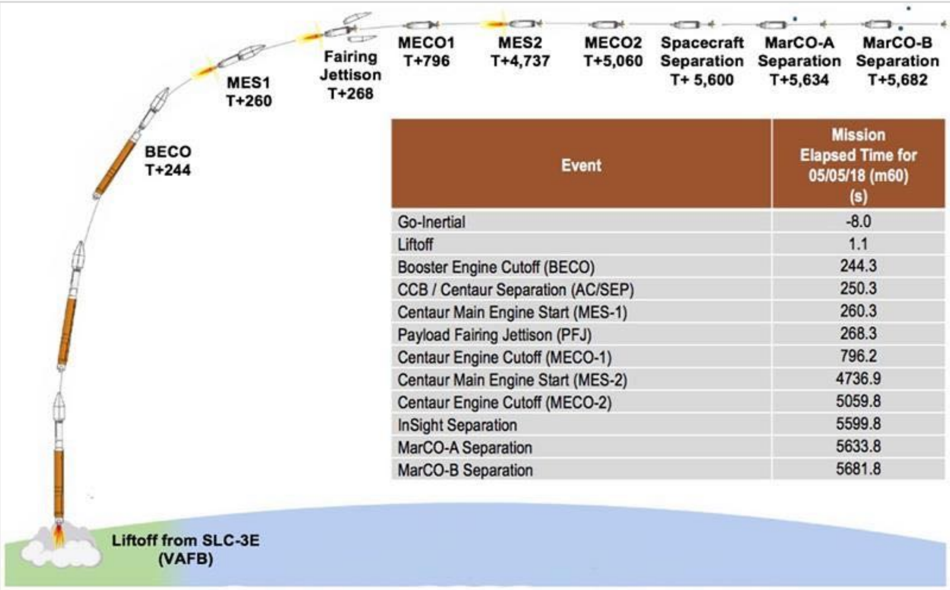
Q3. Read the text of document 4 and using the data in bold draw the graph representing the evolution of the speed of the lander as a function of altitude.

Q4. Describe the evolution of the speed of the lander during the landing phase.

DOCUMENT SHEET

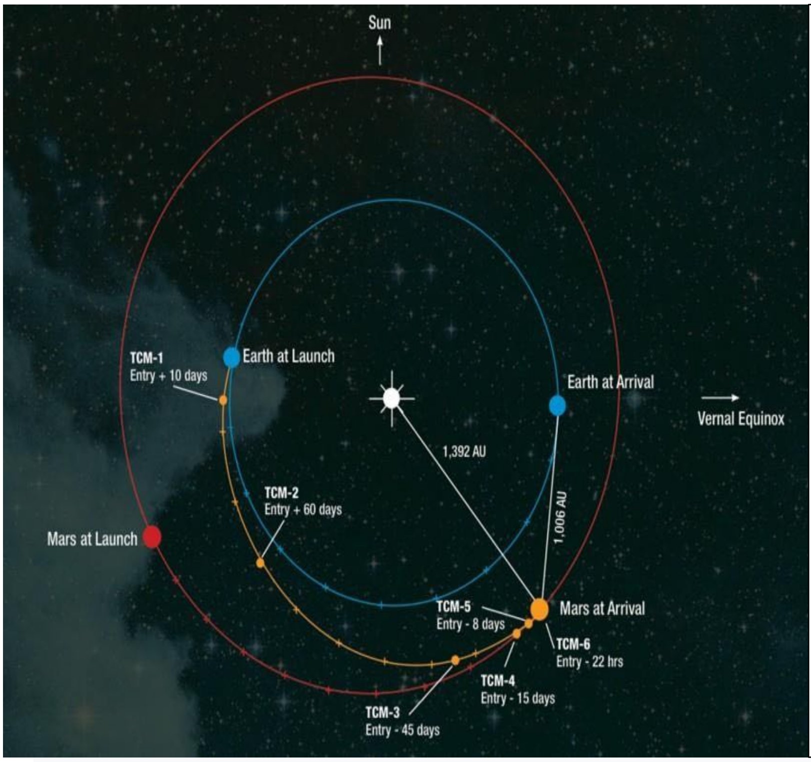


DOCUMENT 1: Structure of the Atlas V 401 launcher used for the InSight mission. (© NASA/ULA).



Event	Mission Elapsed Time for 05/05/18 (m60) (s)
Go-Inertial	-8.0
Liftoff	1.1
Booster Engine Cutoff (BECO)	244.3
CCB / Centaur Separation (AC/SEP)	250.3
Centaur Main Engine Start (MES-1)	260.3
Payload Fairing Jettison (PFJ)	268.3
Centaur Engine Cutoff (MECO-1)	796.2
Centaur Main Engine Start (MES-2)	4736.9
Centaur Engine Cutoff (MECO-2)	5059.8
InSight Separation	5599.8
MarCO-A Separation	5633.8
MarCO-B Separation	5681.8

DOCUMENT 2: InSight launch timeline (© NASA).



Contrary to what one might think, the rocket used for InSight is not pointed directly at Mars, quite the contrary. Planetary protection rules, which state that in Mars exploration, everything must be done to avoid contaminating the red planet with terrestrial germs, have an astonishing consequence here. Martian robotic craft are effectively launched in such a way as to miss their target, this to prevent the upper stage of the launcher, which follows the probes on their way, from crashing into Mars.

InSight not being fired precisely in the direction of Mars, trajectory correction maneuvers are programmed throughout its journey to eliminate the drift placed voluntarily at the start, and to bring the probe back on the right path.

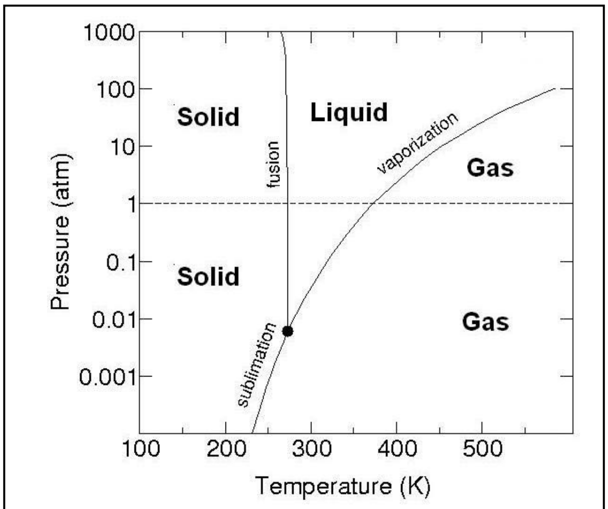
Baptized TCM, there ae six maneuvers.

DOCUMENT 3: Orbit followed by the probe

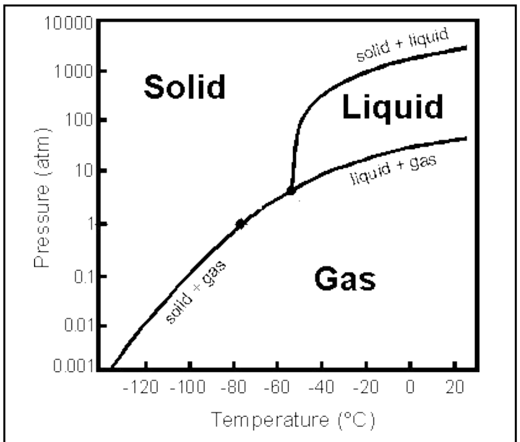
InSight's landing phase is the most critical of the entire mission.
It begins exactly three hours before contact with the highest layers of the Martian atmosphere, about **125 kilometers from the surface.**
For a minute and a half, the capsule containing InSight will slowly turn on itself to point its heat shield forward, in the direction of Mars. Its speed is then very important, since it rushes towards the Martian soil at a hypersonic speed of approximately **22,680 km/h.**
After entering the atmosphere, the second stage of InSight's landing consists of a parachute descent. This the latter will deploy at an altitude of about 9 km.
Fifteen seconds after parachute deployment, at an altitude of about **7.2 kilometers**, the speed of the lander is about **443 km/h.**
At an altitude of about **1.3 kilometers**, while still moving at a speed of 224 km/h, InSight separates from its parachute.
At **50 meters** from the ground, when the vertical speed is only **30 km/h.**
When InSight finally hits the surface after traveling hundreds of millions of miles through space, its average vertical speed is only about **8 km/h.**
According to: https://www.seis-insight.eu/fr/

DOCUMENT 4: Arrival on Mars

PART III – Martian Problems.



The H_2O Phase Diagram



The CO_2 Phase Diagram

These diagrams above are called **phase diagrams**. The one to the left shows all of the phases for matter for water as you change the temperature and pressure of the water in your sample. A pressure of 1.0 ‘atmospheres’ is what we experience at sea level. This equals 14 pounds/inch^2 (or in metric units about 100 kiloPascals). As you move horizontally across the diagram towards increasing temperatures (measured in Kelvin units) at a constant pressure of
1.0 atm, the state of your water will change from solid ice, to liquid water at 273 Kelvin, to water vapor at 373 Kelvin.

Snow balls require that you create some liquid water by compressing the snow crystals so that they can glue together as the water refreezes. This will happen along the curve marked 'fusion' which is the boundary between the solid ice and liquid water phases.

The diagram to the right shows all of the phases for carbon dioxide as you change its pressure and temperature. For convenience we use the Celsius temperature scale. Note that 0^o Celsius = +273 on the Kelvin scale, and that a difference of 1^o C equals a change by 1 K on the Kelvin scale.

Problem 1 - We can make snow balls because the pressure (close to 1.0 atm) we apply withour hands at the ambient temperature (close to 273 K) is just enough to melt the ice into water and refreeze it to form a glue holding the snowflakes together. The temperature in Antarctica is typically 250 K. Can you make snowballs in Antarctica with normal hand pressure?

Problem 2 - On Mars, the majority of the ice is carbon dioxide ice. To make a carbon dioxide snowball, imagine applying 1 atm of hand pressure. The average temperature where the carbondioxide snow falls is about -40^o Celsius in the daytime. Use the phase diagrams to explain why making a showball on Mars may be difficult or easy?

PART IV – Let's create a rover!

Mars rovers have always fascinated and stimulated the imagination of the youngest.
Today, it's up to you to make a rover or at least a rolling object.

Models of NASA Mars rovers. From left to right: Mars Exploration Rover, Sojourner and Curiosity.

For this technological challenge, two levels:

Junior level - Design and build a rolling object moving independently over a minimum distance of 3 meters on horizontal ground and comprising an electrical circuit and carrying a mass of 100g.

Expert Level - Design and build a rolling object moving autonomously over a minimum distance of 3 meters on horizontal ground and comprising an electrical circuit and carrying a mass of 100g, as quickly as possible.

One to two rolling objects per school and the production will include:
- A video showing the rolling object performing the challenge
- A written and illustrated diary of the challenge, including a diagram of the rolling object and keeping the written traces of the tests, the research and any knowledge acquired

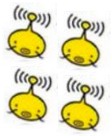
Namazu will appreciate the fact that the challenge is successful (or at least attempted), but also the research, originality and style.

PART V – On the air, in three, two, one… over to you!

During this school year, the Namazu challenges have allowed you to better understand the InSight mission. Today, it is time to make the report of the mission. Unfortunately, Philippe Lognonné (the father of the InSight seismometer) and his colleagues are tired and they give you the mission to present this report for them.

Your mission :

- Collect the latest mission information
- Present to the camera the current assessment of the mission in the manner of a television interview
- Speak for a maximum of 2 minutes



Help: https://www.youtube.com/watch?v=1aOQaCa0UCs

The video must be uploaded to a file transfer site for which you provide the link.