Practical Session n°11: Propulsion

1 - Problem
How can the rocket Ariane take off and fly away from the Earth? Suggest an explanation.

2 - Experiments to understand how propulsion works

2.1 - Situation 1
Available equipment
a wagon, a rubber band, a string, overloads, matches, a steel ball.

Carry out an experiment with the set up shown on pictures 1 and 1' (wagon without overload).

Record your observations.
Explain the experiment the most rigorously as you can on your report.

Help card: How to structure a reasoning

Before the burning of the string
- What can be said about the vector addition of the external forces acting on the system \{ wagon + steel ball \}? Justify your answer.
- What can be said about the momentum vector of this system?

After the burning of the string
- Draw a diagram of the experiment.
- Represent the momentum vector of the wagon \( p_1 \) and the momentum vector of the steel ball \( p_2 \) on your diagram.
- What can be said about the vector addition of the external forces acting on the system \{ wagon + steel ball \} knowing that the friction forces exerted by the air can be neglected? Justify your answer.
- What can be said about the vector momentum of the system \{ wagon + steel ball \}? If a system is composed of 2 different parts, its momentum is the sum of the momentums of each part: \( \mathbf{p} = \mathbf{p}_1 + \mathbf{p}_2 \)

Anticipation: If overloads are added to the wagon, does the wagon go: 

- slower? 
- at the same speed? 
- faster?

Justify your answer.

How to check your anticipation
- Place two overloads on the wagon (see picture 2).
- Conclude.
- Change your arguments if necessary.

2.2 - Situation 2
- Inflate the balloon.
- Place the balloon on the tube fixed onto the wagon (see picture 3) and keep your finger on the tube’s extremity so that it doesn’t deflate.
- Remove your finger.
- Record your observations.
- Interpret this experiment.

3 - Conclusion
Explain how the propulsion of Ariane works using the conclusions of your experiments and the following video.
http://tinyurl.com/rocketPS11

Find out other examples for which this phenomenon is involved.