Reaction velocity

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Subject: Chemistry.
Country of creation: Portugal.
Countries of testing: Czech Republic, Finland and Poland.

Aims of the GP

Students will learn:

- How to draw a graph on graph paper.
- That the concentration of the reagents influences the reaction velocity.
- That a mobile phone could be a valuable sensor.
- How to interpret a reaction velocity graph.

Teaching material

- Two plastic water bottles.
- Vinegar.
- Sodium bicarbonate.
- Electronic scale.
- Mobile phone with video recording capability.
- Computer.
- Graph paper.
- The following YouTube videos:
  http://www.youtube.com/watch?v=KI1BJL3bg1M
  http://www.youtube.com/watch?v=wiZVC6P8vmU

Image 1: Scale picture by Carlos Cunha

Age of the students

12-15

Preparation and teaching time

2 x 90 min classes.

Lesson plan

The experiment: the students will work on a very simple reaction between an acid (vinegar) and sodium bicarbonate, which produces carbon dioxide gas. This gas goes to the atmosphere producing some mass loss on the scale. This is the variable that is registered.

- Theme presentation using a YouTube movie (5 min).

- Discussion about the scale and how to make registrations (15 min).
- Experiment preparation (15 min).
- Record the evolution of the mass during the reaction, using a mobile phone (20 min).
- Play the movie, frame by frame and make a time versus mass table (20 min).
- Construct a mass vs. time graph on graph paper (40 min).
- Repeat the procedure with different reagent concentration (20 min).
- In order to develop ICT skills, students should also produce the graph using a spreadsheet application and compare it with the one they have made on graph paper (30 min).

Tips: Each group of students should use a different vinegar concentration and the same mass of bicarbonate. Comparing all the graphs should make then conclude the influence of the concentration on the reaction velocity.

Questionnaire

Are chemical reactions always reversible processes?

Yes / No

If a chemical reaction occurs with the production of a gas, in an open vessel, the mass will

Decrease its value.
Increase its value.
Maintain its value.

In a chemical reaction, the mass of a reagent

Decreases its value.
Increases its value.
Maintains its value.

In a chemical reaction the mass of a substance varies

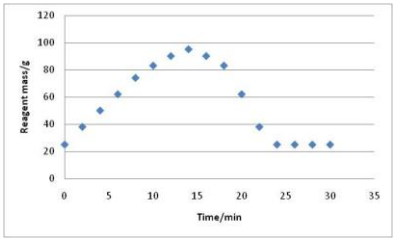
More as time goes by.
Less as time goes by.
Constantly as time goes by.

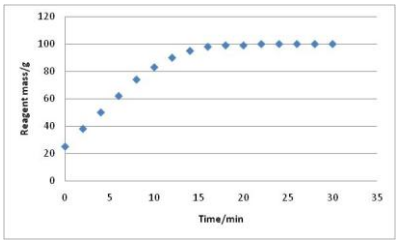
Lavoisier´s law states that

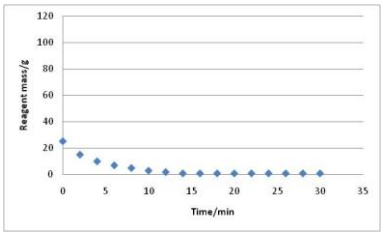
The total mass of the reagents is equal to the total mass of the products.
The total mass of reagents is lower than the total mass of the products.

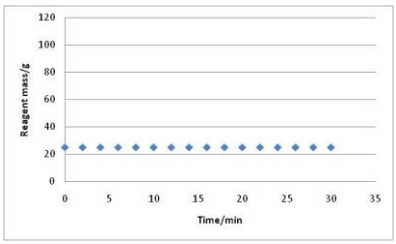
The total mass of reagents is higher than the total mass of the products.

If we represent the mass variation of a reagent with time, the graph that we get is





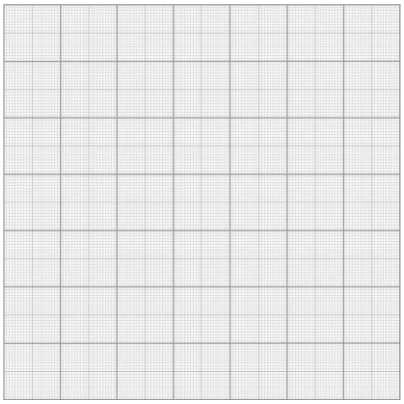




The variation of water temperature in a boiler with time is represented in the following table:

Time/min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
Tempera-ture/ ºC	25	38	50	62	74	83	90	95	98	99	99	100	100	100	100	100

Use the following piece of graph paper to represent the variation of the water temperature with time.



Teacher reviews

The teachers that implemented this GP all applauded the idea of using mobile phones during the experiments, as they noticed that this was extremely effective and motivating for the students. According to the Polish teacher the students "were taught how to make graphs and avoid mistakes. The GP worked both with younger as well as older students because of the power of [obtaining] visible results, namely the carbon dioxide gas that we see bubbling and foaming as soon as we mix baking soda and vinegar. Two common materials, non hazardous and safe, found in almost every kitchen, help us understand the basic postulate of chemical kinetics that 'The velocity of chemical reaction at a given moment of time is proportional to the concentrations of reagents raised to certain power'."

The SPICE project

SPICE was a two-year project (December 2009 – November 2011) carried out by **European Schoolnet** (http://europeanschoonet.org) together with **Direção Geral de Inovação e Desenvolvimento Curricular** (http://sitio.dgidc.min-edu.pt/Paginas/default.aspx) from Portugal and **Dum Zahranicnich Sluzeb MSMT** (http://www.dzs.cz/) from the Czech Republic.

The primary objective of the SPICE project was to collect, analyse, validate and share innovative pedagogical practices, particularly those using inquiry-based learning, whilst enhancing pupils' interest in the sciences. SPICE supported this objective by singling out, analysing and validating good practice pedagogies and practices in maths, science and technology (mostly ICT-based) and disseminating them across Europe. SPICE involved 24 teachers from 16 different educational systems (from 15 different countries). This teachers' panel helped the SPICE partners in defining good practices that were then tested in classes by 41 teachers during the school year 2010-2011.

For more information see: **http://spice.eun.org**

Education and Culture DG
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