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Chemical reactivity: teaching and learning problems and attempted solutions

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2016-06-10
http://hdl.handle.net/10539/20457

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Prosody

Spontaneity has nothing to state
When it comes to the question of rate
Any given reaction may reach it's fate
Tumbling fast or crawling willy nilly late.

The description spontaneous reaction has to do with fate not with rate.

The rate of a reaction can be increased by use of a catalyst.

However if a reaction is not spontaneous it would be futile to try to use a catalyst to speed up the reaction.

All natural changes are spontaneous.

What types of reaction are spontaneous reactions?

(a) Reactions that absorb energy to form products can be spontaneous
(b) Reactions that release energy when forming product can also be spontaneous.

There is a definite direction of spontaneous change. The reverse processes never proceed spontaneously under the same conditions.

Each of the spontaneous processes illustrated occurs of its own accord. You will have noticed that the minimisation of energy is not an adequate criterion for defining a spontaneous change.

The direction of change which leads to the greater dispersal of energy seems to underpin all the spontaneous processes:

SUMMARY OF IDEAS ABOUT CHEMICAL REACTIVITY DEALT WITH SO FAR.

Session 1,2 and 3 handout 21

SESSION 1

Pupils are not empty vessels and new knowledge is not arbitrarily incorporated in their cognitive framework. New knowledge to be acquired depends on the child's existing knowledge.

The model for learning scientific ideas can be summarised as follows:

1. Elicitation
2. Awareness
3. Generation
4. Moving towards a better understanding.

SESSION 2

Reactivity is the tendency or not the tendency of a reactant to form products in a chemical reaction. The word tendency implies that the system is poised to undergo a certain natural change. Although poised for change the change may not be realised and furthermore the rate at which the change will take place is not referred to.

Tendency or readiness can be interpreted in either a kinetic sense or a thermodynamic sense.

Various approaches can be used to measure the reactivity of a substance:

a) The speed with which the substance reacts.
b) The total energy changes in a reaction.
c) Voltage measurements.

These methods *are different and thus do not necessarily* give the same order of the elements.

Reactivity series

A reactivity series is a series in which the elements are put in an approximate "batting order". The order of the elements in the series will be dependent on what the criterion for ordering was. Either speed or total energy considerations may have been used for example.

SESSION 3

A spontaneous reaction is a reaction that may proceed *without the assistance of an external agency.*

A reaction is described as spontaneous or non-spontaneous without reference to rate. The descriptions indicate whether a reaction may take place or not. An excerpt of a prosody encompasses the salient aspects of spontaneity.

A series of examples are give below. Some take in energy from the surrounding and some give off energy to the surroundings.

16. *Hydrated copper sulphate heated continuously is a spontaneous reaction.*

$CuSO_4.5H_2O(s)$ -----> $CuSO_4(s) + 5H_2O(l)$.

Incorrect scientific statement.

Since energy is provided continuously the process is not natural.

17. *Hoffmans voltameter: Electrical energy is supplied continuously at 25°C to decompose water. This is an example of a non-spontaneous reaction.*

$2H_2O(l)$ ------> $2H_2(g) + O_2(g)$

Correct scientific statement.

Since energy is provided continuously the process is not natural.

18. *Butane gas burning from a cigarette lighter is an example of a spontaneous reaction.*

$2C_4H_{10}(g) + 13O_2(g)$ ----> $8CO_2(g) + 10H_2O(g)$

Correct scientific statement.

Since energy is not provided continuously the process is natural and spontaneous. The spark only provides the activation energy.(i.e minimum energy necessary for the reaction to occur)

19. *A spontaneous reaction has to take place immediately.*

Incorrect scientific statement.

A reaction can take some time before it gets started. The time taken for a reaction takes to start is not a criterion for spontaneity.

20. *A spontaneous reaction takes place without delay.*

Incorrect scientific statement.

A reaction can take some time before it gets started. The time taken for a reaction takes to start is not a criterion for spontaneity.

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Name of thesis: Chemical reactivity - teaching and learning problems and attempted solutions.

PUBLISHER:
University of the Witwatersrand, Johannesburg
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