

Historical burdens on physics

16 Physical and chemical processes

Subject:

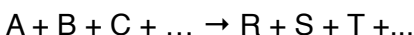
The following citations are from chemistry text books:

“Processes, in which substances are transformed into other substances, are called chemical processes. In a physical process in general the state of a substance changes, whereas the essential properties remain unchanged: Sulfur remains sulfur, even if it is melted or vaporized.”

“Chemistry is the science of the substances and their changes. Physics on the contrary investigates the states and changes of the states of substances.”

Deficiencies:

1. The border line between physics and chemistry is drawn inappropriately: between the “chemical reaction” and the phase transition. However, these processes are tight relatives. It would be more convenient to stress their similarities. Both classes of processes can be described with the same methods and concepts. A chemical reaction can symbolically be written as



A phase transition is that particular case, in which on the left and on the right side of the reaction arrow there is only one single substance, in symbols:



This peculiarity, however, does not cause any essential difference in the mathematical treatment of the corresponding problem. The driving force for both types of processes is a difference of the chemical potentials between the reactants and the products. The value of the chemical potentials is taken from the same table in both cases. Also the heat balance is calculated by the same procedure and with values of the same table. In both cases there are exothermic and endothermic processes, both types of processes can be carried out reversibly and irreversibly.

2. If the definition is chosen as it is done here, one gets onto scrape anyway. The criterion for a process to be chemical is the formation of a new substance. But what is a new substance? Is a solution process physical or chemical? Is it chemical when hydration takes place and physical when not? Are gaseous, dissolved and crystalline NaCl different substances? And what about processes that occur in a solid material: The reaction of lattice vacancies with interstitial atoms or ions, the reaction of electrons with holes?

Origin:

It is not inequitable to explain what it is about when beginning a new subject area. It is conspicuous however, that chemistry text-books are particularly explicit in establishing a border toward physics. In physics text-books no corresponding efforts are made to demarcate the limit with chemistry. By

the way, there are no tendencies to bulkhead between physics and electrical engineering, neither from one nor from the other side.

Disposal:

Instead of stressing the differences between phase transitions and “true” chemical reactions, it is better to treat these processes as particular cases of the same class of processes, to which many others also belong: the reaction of electrons with holes, the reaction of material substances with light, the reaction of interstitial atoms with lattice vacancies, the reaction of atomic nuclei ...

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