4.1: Types of Processes

Any conceivable process is either spontaneous, reversible, or impossible. These three possibilities were discussed in Sec. 3.2 and are summarized below.

- A *spontaneous* process is a real process that can actually take place in a finite time period.
- A *reversible* process is an imaginary, idealized process in which the system passes through a continuous sequence of equilibrium states. This sequence of states can be approached by a spontaneous process in the limit of infinite slowness, and so also can the reverse sequence of states.
- An *impossible* process is a change that cannot occur under the existing conditions, even in a limiting sense. It is also known as an unnatural or disallowed process. Sometimes it is useful to describe a hypothetical impossible process that we can imagine but that does not occur in reality. The second law of thermodynamics will presently be introduced with two such impossible processes.

The spontaneous processes relevant to chemistry are *irreversible*. An irreversible process is a spontaneous process whose reverse is an impossible process.

There is also the special category, of little interest to chemists, of purely mechanical processes. A purely mechanical process is a spontaneous process whose reverse is also spontaneous.

It is true that reversible processes and purely mechanical processes are idealized processes that cannot occur in practice, but a spontaneous process can be *practically* reversible if carried out sufficiently slowly, or *practically* purely mechanical if friction and temperature gradients are negligible. In that sense, they are not impossible processes. This e-book will reserve the term "impossible" for a process that cannot be approached by any spontaneous process, no matter how slowly or how carefully it is carried out.