

3.2: The First Law of Thermodynamics

We finally come to a working definition of the first law. If we take an isolated system—i.e., a system that does not exchange heat nor mass with its surroundings—its internal energy is conserved. If the internal energy is conserved, $dU = 0$. Therefore, for an isolated system:

$$dQ = -dW,$$

and heat and work can be easily calculated using any of the appropriate formulas introduced in either section [2.4](#) or [2.3](#).

The first law is a conservation law. It is intuitive since it comes directly from Lavoisier's principle of "nothing is lost, nothing is created, everything is transformed." Considering that the only system that is truly isolated is the universe, we can condense the first law in one simple sentence:

Definition: First Law of Thermodynamics

First Law of Thermodynamics: The energy of the universe is conserved.

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