

The first law of thermodynamics

The first law of thermodynamics is simply the principle of conservation of energy applied to a thermodynamic system under going for some change. It has been stated in three different ways. All the statements are equivalent to each other. In the simplest form it is stated as follows :-

"Whenever work flow is completely converted into heat or vice versa, one is proportional to the other. If W is the work flow to a system and Q is the heat produced

$$W \propto Q$$

or $W = JQ$

or in another words we can say :-
In all transformation, the in flow of energy to a system in the form of heat must be equal to the out-flow of energy in the form of work plus the increase in internal energy of the system.

If ΔQ is the heat flow to a system
 ΔW is the work - done by the system
and ΔU is the increase in internal
energy of the system and all the
energies are taken in the same
unit, namely, either joule or calorie.
then

$$\Delta Q = \Delta U + \Delta W \quad \text{--- (1)}$$

Our system undergoes an infinitesimal
change in state only an infinitesimal
amount of heat dQ is absorbed and
only an infinitesimal amount of work
 dW is done, so that the thermal
energy change dU is also infinitesimal,
we can write it as follows: -

$$dQ = dU + dW \quad \text{--- (2)}$$

This is the differential form of
the first law of thermodynamics.
In third form it is stated as
follows: - Perpetual motion of the
first kind is impossible.

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