Biophysical Chemistry
First Law of Thermodynamics
Lecture-2

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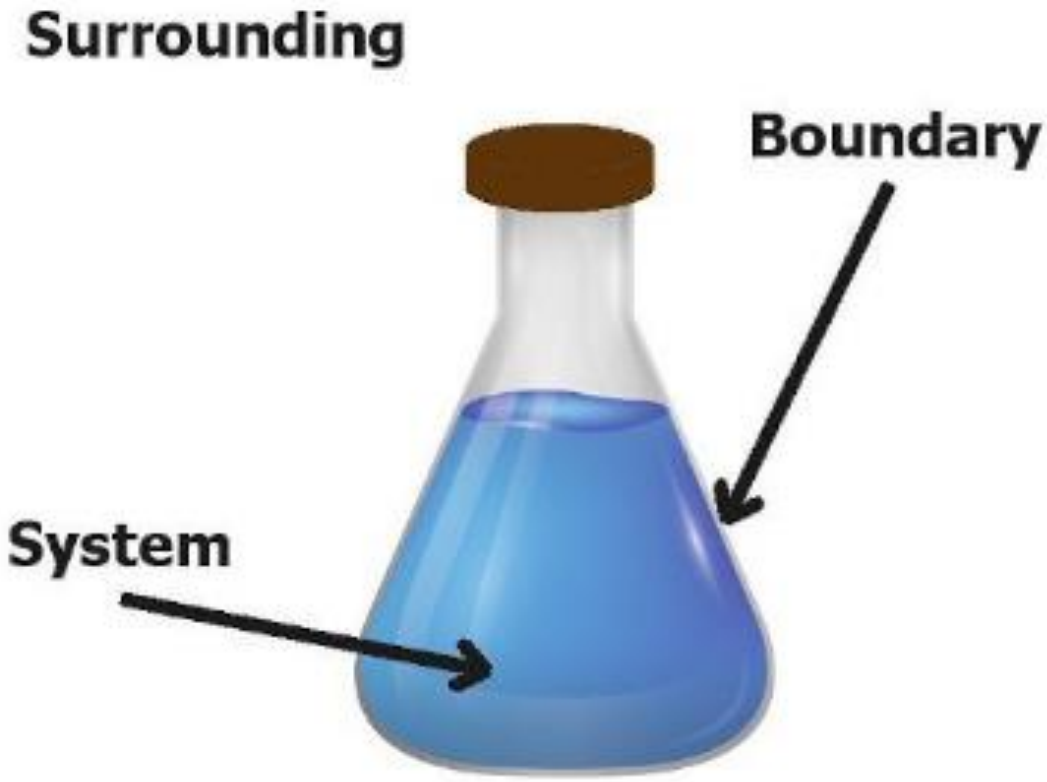
What is heat? How is it related to the 1st law of thermodynamics?

Definition of heat: Heat is defined as a flow of thermal energy due to differences in temperatures.


I feel hot because
heat enters my body
from the surrounding


Surrounding
Boundary
System

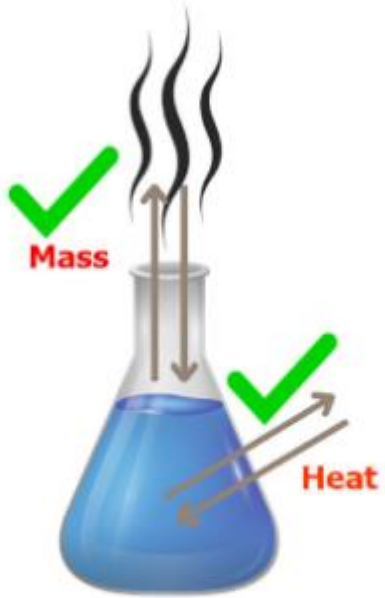
Thermodynamic system: System is defined as a part of the universe which is chosen for thermodynamic study.

Surrounding: The region outside the system is known as surrounding.

Boundary: The actual or imaginary line which separates the system and surrounding is known as boundary (see figure).

Universe: The combination of system and the surroundings together is usually referred to as universe.

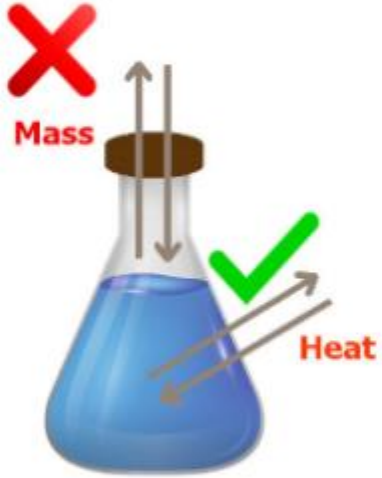
What is Thermodynamic System? – Open, Closed & Isolated (With Examples)



Open system

Mass transfer (yes)

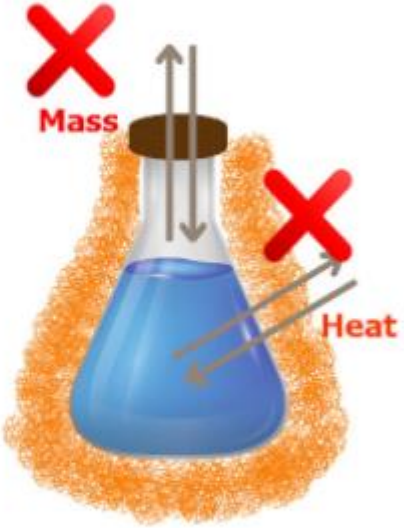
Heat transfer (yes)



Closed system

Mass transfer (yes)

Heat transfer (No)



Isolated system

Mass transfer (No)

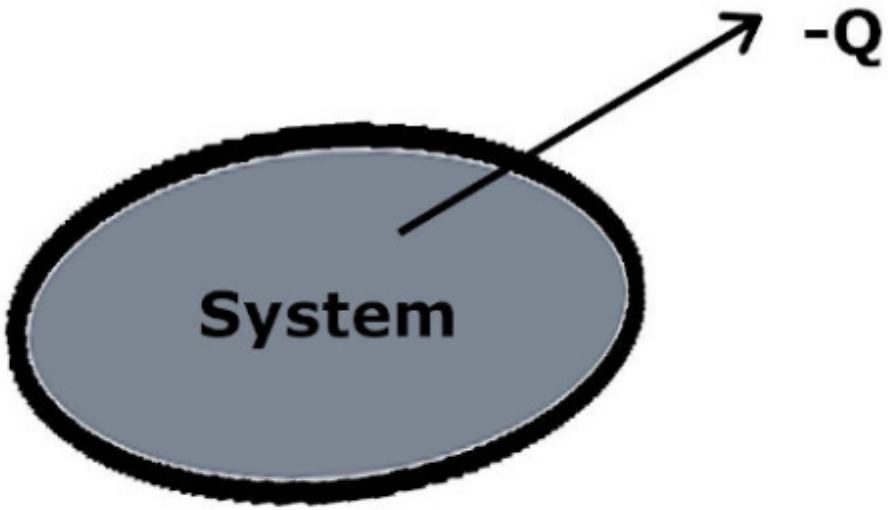
Heat transfer (No)

Sign convention of heat in first law of thermodynamics

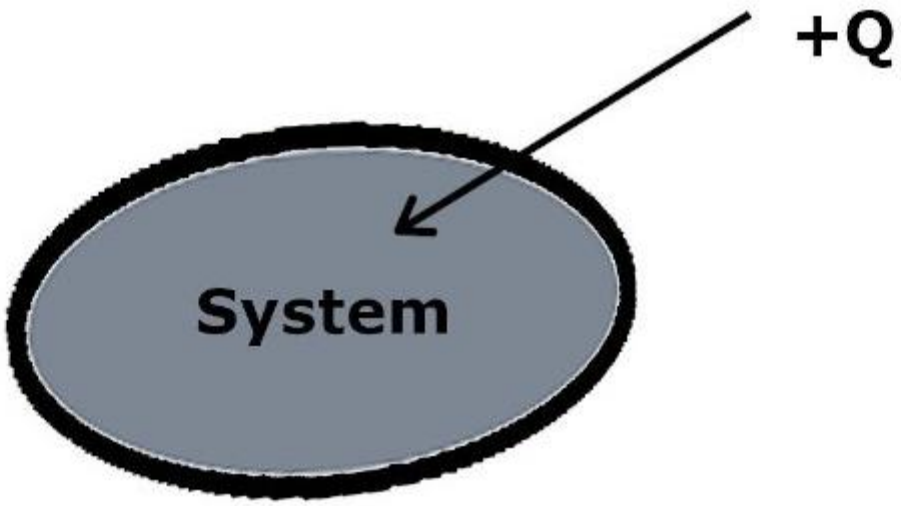
When the equation of 1st law of thermodynamics is used in calculations, it is necessary to know the sign of the heat(Q) and work(W).

Here I'll show you the sign of heat (+ve or -ve).

When we should take Q as +ve and when we should take Q as -ve?



- When the heat is lost from the system, then we have to take Q as -ve. (Remember, if heat is going then minus sign)



- When the heat is supplied to the system, then we have to take Q as +ve. (Remember, if heat is coming then plus sign)

Classification of Energy

There are two more classification of energy:

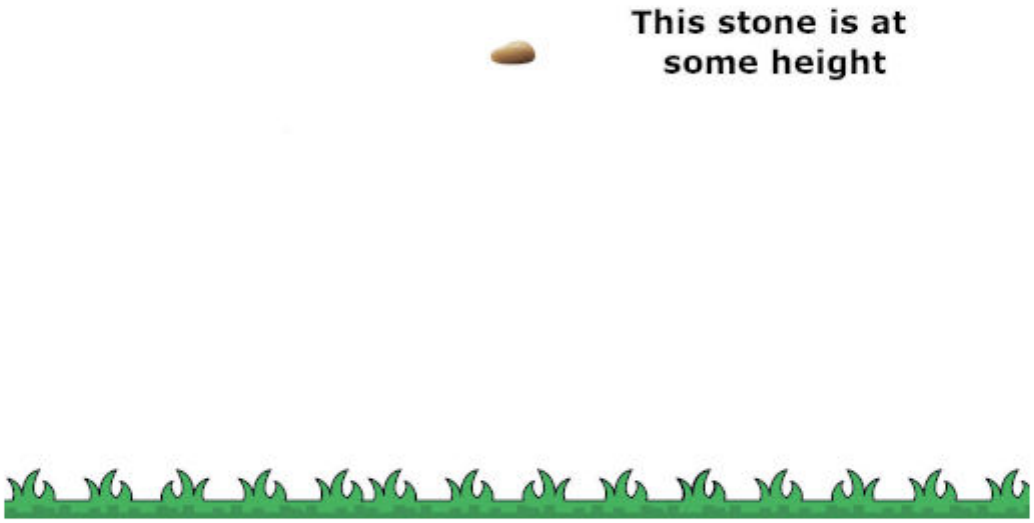
1.Kinetic energy

2.Potential energy

Kinetic energy: Kinetic energy is the energy which an object possesses due to its motion.

For example, if any object is moving with some *velocity*, then it possesses kinetic energy.

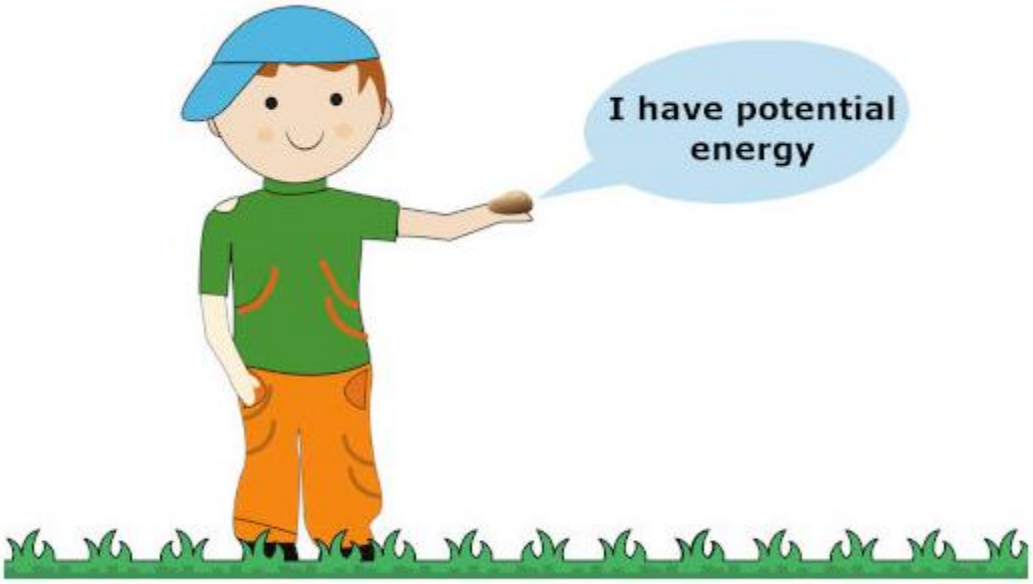
Potential energy: Potential energy is the energy stored in a body due to its position with respect to some other body.



For example, this stone is at some height with respect to ground. So, it contains potential energy in it.

Potential Energy Converted to Kinetics Energy

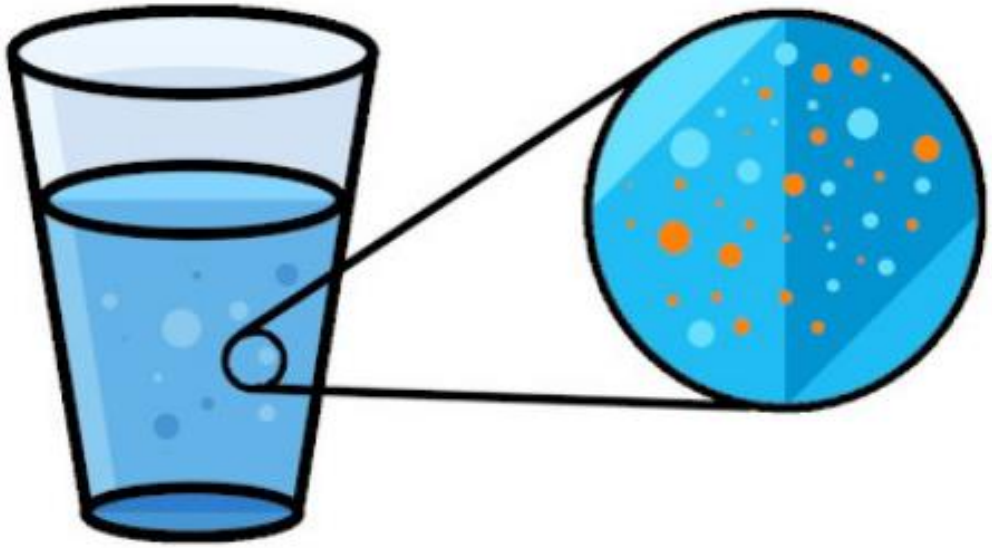
This kinetic energy and potential energy are converted from one form to another.



Now what happens when this boy releases this stone?

The potential energy of stone is converted into kinetic energy.

What is Internal energy in first law of thermodynamics?

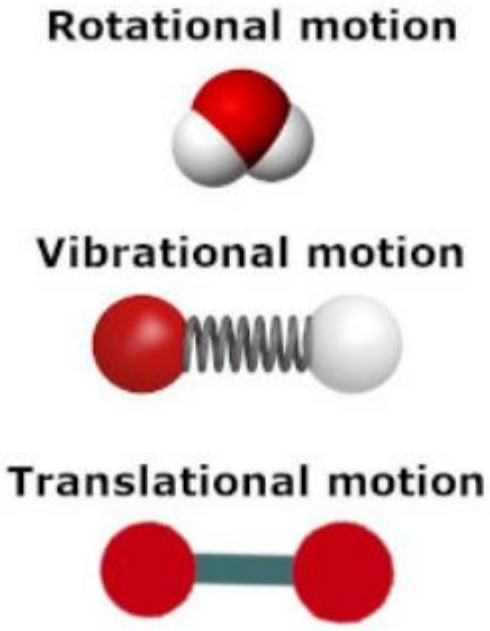


Water molecules performs various types of motion like;

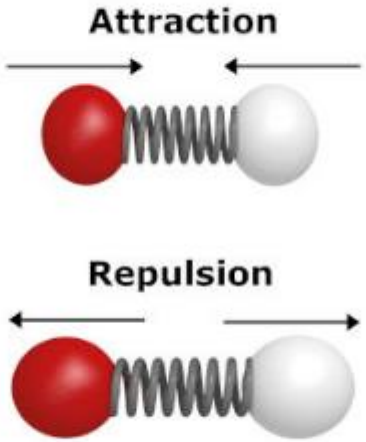
Rotational motion

Vibrational motion

Translational motion



If we increase the temperature of water then these motions also increases and because of this, the kinetic energy of molecules also increases.



The molecules are also bound with each other with a force of attraction and they also experience a repulsive force.

These attractive and repulsive forces indicates the potential energy.

In short, the molecules of all the objects possess kinetic energy and potential energy.

Internal energy

Internal energy = the sum of all the molecular kinetic energy + the sum of all the molecular potential energy

Internal energy is nothing but the sum of this molecular kinetic energy and molecular potential energy.

- Internal energy is associated with the temperature of the object.
- If the temperature is higher, then the internal energy is more.
- If the temperature is lower, then the internal energy is less.