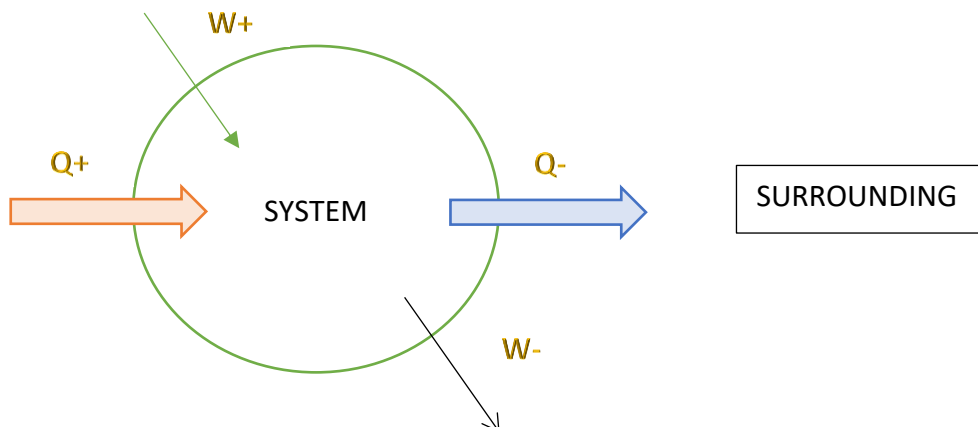# Thermodynamics

- **Frist Law of Thermodynamics** states that energy can neither be created nor destroyed; energy can only be transferred or changed from one form to another.
- There are two kinds of processes: heat (Q) and work (W). They can lead to change in internal energy (ΔU).

W+

Q+   Q-   SURROUNDING

SYSTEM

W-

Equation: **ΔU= Q + w**

- ❖ Heat (Q):
  - o When heat is absorbed by the system (heat flows **from** the surrounding **to** the system), it has positive value (Q+). It is also called **endo**thermic process. At the same time, because the surrounding loses the heat to the system, the heat of the surrounding has negative value (Q-)

  SYSTEM   Q+   Q-   SURROUNDING
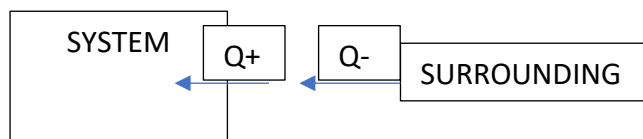
  - o When heat is released by the system (heat flows **from** the system **to** the surrounding), it has negative value (Q-). It is also called **exo**thermic process. At the same time, because the surrounding gains the heat from the system, the heat of the surrounding has positive value (Q+)

  SYSTEM   Q-   Q+   SURROUNDING
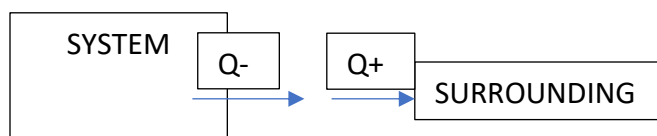
❖ Work (W):
  o When work is done **on the system** by the surrounding, it has positive value (w+)
  o When work is done **by the system** on the surrounding, it has negative value (w-)

Let's go over some examples:

1. Calculate the change in internal energy of a system if 300 J of heat energy **is released** by the system, and if 400 J of work is done **by the system** on the surrounding.

   • Because heat energy is released by the system, Q = -300 J. Work is done by the system, so w = -400 J. Plug these two numbers in the equation, we have:

   $$\Delta U = (-300 \text{ J}) + (-400 \text{ J}) = -700 \text{ J}$$

2. What is the change in internal energy of the system if **the surrounding gains** 250 J of heat energy and if 470 J of work is done **by the system**

   • Because the surrounding gains 250 J of heat energy, Q of the surrounding = +250 J. That also means that Q of the system = -250 J because it releases energy to the surrounding.
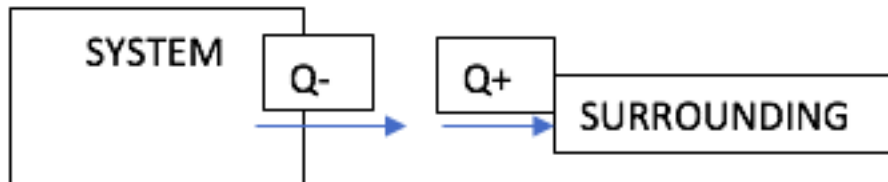
   • Work is done by the system on the surrounding will make w of the system = + 470 J. Plug those two numbers in the equation, we have:

   $$\Delta U = (-250 \text{ J}) + (470 \text{ J}) = 220 \text{ J}$$