MOHAMED KHIDER UNIVERSITY OF BISKRA.

FACULTY OF EXACT SCIENCES AND NATURAL AND LIFE SCIENCES

DEPARTMENT OF BIOLOGY

Semester2: THERMODYNAMICS AND CHEMISTRY OF MINERAL SOLUTIONS

CHAPTER III

Level: 1st year LMD

Dr: Ismail DAOUD

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1. Thermodynamics

It is a part of chemical thermodynamics that covers all the energy exchanges that accompany changes of state and chemical reactions.

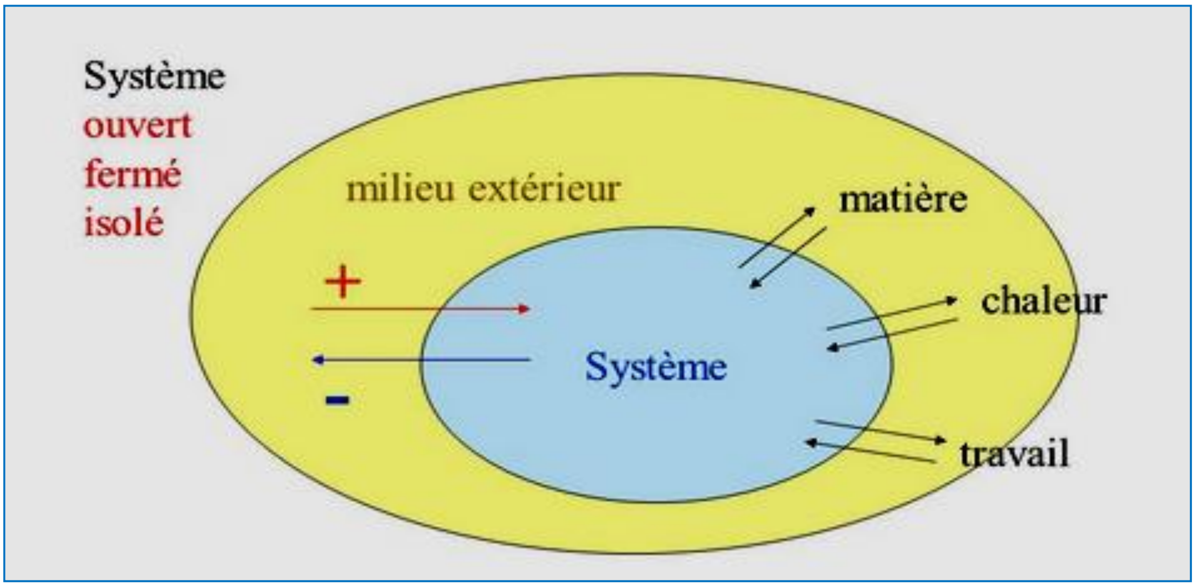
Some reactions release heat, these are exothermic reactions,

Some reactions can absorb heat, they are endothermic.

1.1. Thermodynamic systems and quantities:

1.1.1. Definitions:

a. A system: The thermodynamic system is the part of the universe subject (الى يخضع) to experimental and theoretical studies. Everything that is not part of the system (the rest of the universe) constitutes the external environment.



The exchanges between the system and the external environment are:

- Mechanical: (pressure force),
- Thermal: (heat transfer)
- Chemical: (material transfer).

Depending on the exchange of energy and matter, three systems can be distinguished:

- Open system: can exchange energy and matter with the external environment.

Example: A living cell is an open system.

Solution in a beaker exposed to temperature

- Closed system: cannot exchange matter. It can exchange heat and work.

Example: A bottle full of water closed in a fridge or in a bain-marie.

- Isolated system: it has no exchange with the external environment.

Example: thermos.

Recaps:

System	**Energy exchange**	**Exchange of matter**
Open	Yes	Yes
Closed	Yes	No
Isolated	Yes	No

Noticed:

The heat and energy exchanged between a system and the external environment are expressed, by convention, by an algebric number:

- Positive: if they are gained by the system at the expense of the external environment.
- Negative: if they are transferred by the system to the external environment.

1.1.2. State variables, state function:

a. The state of a system:

It is defined by a certain number of measurable quantities called state variables such as Temperature (T), pressure (P), Volume (V), number of moles (n), concentration (C), etc. etc.

b. State variables:

Parameters sufficient to unambiguously define the state of a system are called state variables. These variables, in chemistry, are essentially: pressure P, volume V, temperature T and chemical composition (molar fraction (xi), C, n, etc.).

Noticed :

The variation of a state function depends only on the initial state and the final state of the system.

For an infinitely small transformation, the variation of a state function is an exact total differential (dV).

State variables can be classified into two categories:

Extensive variables: they depend on the quantity of matter in the system (magnitude proportional to the size of the system), i.e. these are additive variables (examples: mass, number of moles, volume, etc.).

Intensive variables: they are independent of the quantity of matter in the system, i.e. these are non-additive variables (examples: pressure, temperature, mole fraction, etc.).

Noticed :

We can find that the quotient of two extensive quantities can give an intensive quantity. *Example:* density: $\rho = m/v$: is an intensive quantity (intensive= extensive/extensive).

c. Equilibrium state:

If the system is in equilibrium means that its state variables are constant over time and are the same at every point in the system. The Equilibrium is:

- **Stable:** if the momentary application of a small disturbance is followed by a return to the same state of equilibrium.
- **Unstable:** if the application of a disturbance causes the system to adopt a new state of equilibrium (generally stable).

Noticed:

There is a thermal, mechanical and chemical equilibrium when respectively the temperature, pressure and composition are constant over time.

1.2. Transformation of a system:

For a system there is always an initial state and a final state, there is a modification of one or more state variables.

We distinguish the following transformations:

1.2.1. Reversible transformations: A reversible transformation is a continuous series of thermodynamic equilibrium states, it passes through the same equilibrium states to go from state 1 to state 2 or vice versa provided that the evolution takes place very slowly.

1.2.2. Irreversible transformations: These are transformations: natural, spontaneous, brutal, abrupt or rapid. It does not depend on the path followed, i.e. which does not pass through states of equilibrium.

1.2.3. Isochoric transformations: it takes place at constant volume. (V=constant; DV=0).

1.2.4. Isobaric transformations: it takes place at constant pressures (P=constant; DP=0).

1.2.5. Isothermal transformations: it takes place at constant temperature (T=constant, DT=0).