

Chemical Thermodynamics

INTERNAL ENERGY(E)

Definition: It is the sum total of Translational Kinetic Energy(E_t), Rotational Kinetic Energy(E_j), Vibrational Energy(E_v), Nuclear Energy(E_n), Electronic Energy(E_e) and Molecular interaction Energy(E_i) associated with atoms or molecules of a system.

It is denoted by E.

$$E = E_t + E_j + E_v + E_n + E_e + E_i$$

The absolute value of Internal Energy(E) cannot be determined

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CHANGE IN INTERNAL ENERGY(ΔE)

- ▶ The internal energy of a system is a state function. This is because it depends on the initial and final state of the system, not on how it attains the state. Hence, the change in internal energy depends only on the initial and final state of the system, not on the intermediate states.

$$\Delta E = E_f - E_i$$

ΔE – Change in internal energy

E_f – Internal Energy at final state of the system

E_i – Internal energy of the system at initial state.

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▶ CHARACTERISTICS OF INTERNAL ENERGY

- Internal Energy is an extensive property, depends on amount of substance contained in the system.
- It is a thermodynamic state function.
- It is independent of path followed.
- The internal Energy has complete differential(dE)
$$\int_{E_1}^{E_2} dE = E_2 - E_1$$
- The absolute value of internal energy cannot be determined.
- The amount of internal energy depends on nature of constituents and modes of bonding.
- The amount of internal energy of given system is different under a given set of conditions

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- The change of internal energy is the difference between final internal energy and initial internal energy, $\Delta E = E_2 - E_1$

ΔE -Change in Internal Energy

E_1 –Initial Internal Energy

E_2 -Final Internal Energy

Sign of Change in Internal Energy(ΔE):

The internal energy is positive when $E_2 > E_1$

The internal energy is negative when $E_2 < E_1$

Units of Internal Energy(IE) is Joule in SI System and erg in CGS system

Significance of change in internal Energy: It is equal to exchange of heat energy(q_v) between system and surroundings at constant temperature and constant volume.

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► CHANGE IN INTERNAL ENERGY(ΔE) IN CHEMICAL REACTION:

Let us consider the chemical system, in which a chemical reaction takes place, it will be observed that internal energy before the chemical reaction is not same as after the chemical reaction.

Let ΔE -Change in internal energy during a chemical reaction

E_R -Internal Energy of reactants

E_P -Internal energy of products

then $\Delta E = E_P - E_R$

ΔE is positive, when $E_P > E_R$

ΔE is negative, when $E_P < E_R$