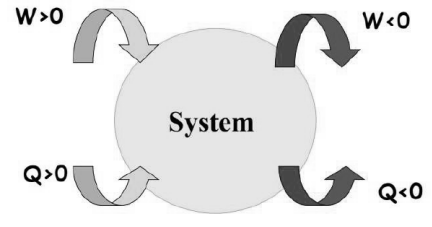
Systems

A system can be open (freely exchanges energy and matter with the surroundings), closed (exchanges energy but not matter) or insulated (does not interact with the surroundings)

Sign conventions



If the system gains heat, it is an endothermic process. If the system releases heat, it is an exothermic process.

Heat

$Q=m•Hs•\Delta T$	not a state function

Work

pressure-volume work	$W=Pext•V$ (if P=constant)
if carried out in a reversible way	$W=-nRT•ln(V2/V1)$

Ideal gas law

$P•V=nRT$	R=0,082 atm•L/(K•mol)

Calorimeter bomb

$Q+W=0=\Delta E$

W=0	Q=0

Qreleased+Qabsorbed=0

Qreaction+Qwater+Qcalorimeter=0

Qreaction+Mwater•(Tf-Ti)+Kcalorimeter•(Tf-Ti)=0

Qreaction=Qv=ΔE

Laws of thermochemistry

Lavoisier and Laplace laws

The energy change accompanying any transformation is equal and opposite to energy change accompanying the reverse process.

Hess Law

The energy change accompanying any transformation is the same whether the process occurs in one step or many. The combination of chemical equations allows to determine unknown heats of reaction.

Standard States. Standard enthalpy of reaction

enthalpy change of a reaction in which all reactants and products are in their standard states

the standard enthalpy of formation of a pure element in its standard state is 0

$\Delta H^o=\Sigma vp•\Delta H^of(products)-\Sigma vp•\Delta H^of(reactants)$

Units

1cal=4,184J

Specific heat	quantity of heat required to change the temperature of one gram of the substance by one degree celsius
Molar heat	quantity of heat required to change the temperature of one mol of the substance by one degree celsius
Heat capacity	quantity of heat required to change the temperature of a system by one degree celsius

First law of thermodynamics

Internal energy is the total energy in a system	$E=\Sigma Ei$
Principle of conservation of energy	$\Delta E=Q+W$
For isolated system	$Q+W=0=\Delta E$

Heat and work are means by which a system exchanges energy with the surroundings

Enthalpy (H)

It is the change in the internal energy when there is only pressure--volume work, and the pressure is constant

$\Delta E=Q+W=Qp-P•\Delta V$	$Qp=\Delta E+P•\Delta V$
H=E+P•V	$\Delta H=\Delta E+V\Delta P+P\Delta V+\Delta P\Delta V$
if P=constant	$\Delta H=Qp=m•Hs•\Delta T=n-•Hs•\Delta T$

Relation of Qv and Qp (gases)

$\Delta H=\Delta E+P\Delta V$

if P and T are constant	$\Delta H=\Delta E+\Delta nRT$

Relation of Qv and Qp (solids and liquids)

if P=constant-->change in volume really small	$Qv\approx Qp-->\Delta E\approx\Delta H$

Enthalpy and bond energy

ΔHr=ΣHbroken bonds-ΣHformed bonds