**THERMODYNAMICS**

**Thermodynamics**

A thermodynamic system can exchange energy with its surroundings in two ways. **Heat transfer** and **mechanical work**. The internal energy of a system changes when either heat transfer or work occurs.

The system does work on its surroundings when its volume changes.

First law of thermodynamics: 

The change of internal energy = (added heat to/transferred heat out of) the system + (work done on/work done by) the system



The change of the internal energy is directly proportional to the change of the temperature



, where **cv** is specific heat capacity at constant volume

(Solving of **m** and **cv**; see the last page)

The thermodynamic system may exchange energy with its environment by means of heat and work

Rules of signs:

When heat is added to the system **Q > 0**

When heat is transferred out of system **Q < 0**

When work is done on the system (gas is pressured) **W > 0**

When work is done by the system (gas expands) **W < 0**

**Transformations (processes) of gases**



On a p-V diagram: Work is area beneath a curve of p versus V



**Isobaric process (pressure is constant)**





, where ***cp*** is specific heat capacity at constant pressure

**Isochoric process (volume is constant)**





W = 0



**Isothermal process (temperature is constant)**







**Adiabatic prosess (system is insulated, no heat transfer)**



, where  (adiabatic constant) is 

Q = 0



**The ideal gas law**

The three thermodynamic quantities that describe a thermal system such as a gas are:

p pressure [Pa] (absolute pressure, not atmospheric pressure)

V volume [m3]

T temperature [K]

 

n = number of moles:  (1 mole is 6,02·1023 molecules)

M = Molar mass: [M] = kg / mol

R = Molar gas constant = 

**\*solving a mass of gas**

**\*\*solving a cv**

**Many tables gives You only a cp (specific heat capacity at constant pressure) and a ratio of (adiabatic constant γ)**