University of Djilali Bounaama of Khemis Miliana
Faculty of Science and Technology
Department: Physics
Second year Bachelor: Physics_(2023/2024)

# Tutorials. No_03: Second law of thermodynamics.

## Exercise 01 :

A 20 $l$ glass of water at a temperature of 7 $^0C$ is left in a room at 18 $^0C$ until thermal equilibrium is reached at18 $^0C$.

1- Calculate the change in entropy created during this process.

We give : heat capacity of water $C_e = 4185\ J.Kg.^{-1}K^{-1}$ ,density of water : $\rho = 1000\ kg\ m^{-3}$

## Exercise 02 :

A calorimeter with a calorimetric capacity of C=150Jk(-1) initially contains a mass $m_1 = 200g$ at a temperature of$T_1 = 20\ ^0C$. The system is in thermal equilibrium. A piece of iron with a mass $m_1 = 100g$ and an initial temperature of $T_2 = 80\ ^0C$ is immersed in the water.

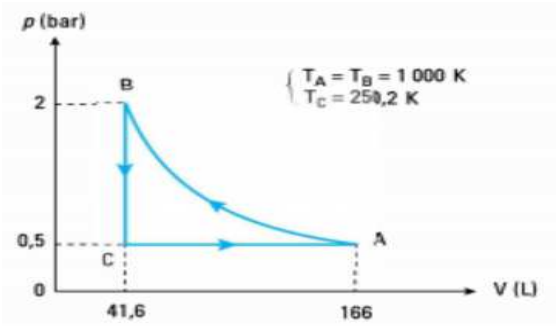
1- Calculate the final temperature Tf, the change in entropy of the iron, and the created entropy.

We give : heat capacity of water $C_e = 4185\ J.Kg.^{-1}K^{-1}$, heat capacity of iron:

$$C_{Iron} = 452\ J.Kg.^{-1}K^{-1}$$

## Exercise 03 :

We consider the following cycle composed of an isothermal process AB, an isochoric process BC and an isobaric process CA, described by one mole of a diatomic ideal gas (with a specific heat ratio, $\gamma = 1.4$).




Calculate the entropy variation of the gas during the three considered evolutions.

## Exercise 04 :

N moles of an ideal gas undergo a change from state A to state B.
Express the variation of this ideal gas:

- In terms of temperature and volume (T and V).
- In terms of temperature and pressure (T and P).
- In terms of pressure and volume (P and V).

## Exercise 05 :

A perfectly insulated container is divided into two compartments (1) and (2) of equal volume V=1 L. The two compartments can communicate through an orifice equipped with a valve. Initially, the valve is closed, the first compartment contains a diatomic gas (gamma=1.4) under pressure p=1 bar and at temperature T=298K, while compartment (2) is empty.

1. The wall between the two compartments is assumed to be perfectly insulated. The valve is opened and closed as soon as thermal equilibrium is reached. It is assumed that the gas remaining in compartment (1) undergoes a reversible adiabatic expansion.
   a) Determine the mechanical equilibrium pressure p' common to the two compartments as well as the respective temperatures T1' and T2'. Let n1' and n2' be the respective amounts of matter in compartments (1) and (2).
   b) Calculate the entropy created Sc' during this process.
2. Repeat the previous question assuming that the wall between the two compartments is permeable to heat exchange.
   a) Determine the pressure p'' and the respective temperatures T1'' and T2''.
   b) Calculate the entropy created Sc'' during this process.
3. Compare the entropy creations in each case and draw conclusions.