Dr. K. Göbel, Prof. Dr. R. Reifarth
http://exp-astro.de/mechanik

Übungen zur Experimentalphysik I (Thermodynamik)
Aufgabenblatt 3 von 5
Abgabe im OLAT: Montag, 01.02.2021, 18:00 Uhr

GOETHE
UNIVERSITÄT
FRANKFURT AM MAIN

1)
Carry out an experiment where the entropy of a subsystem is reduced. Discuss the change in the entropy of the entire system.

2) Winter is coming
There is 1 kg of ice at $T = 0°\text{C}$ and $p_0 = 1.0133 \cdot 10^5$ Pa. Calculate the increase in entropy when the ice has melted completely leaving water at $T = 0°\text{C}$. The volume is constant. The specific heat of fusion is 333.5 kJ/kg.

3) Pasta?
How much entropy do you need to heat up 1 kg of water from 0°C to 100°C? Neglect the change in volume and use the constant heat capacity of 4.184 J/(g K).

4) Not ideal...
You have one mole of water.
a) Calculate the volume of water vapor at T = 100°C at a pressure of $p_0 = 1{,}0133 \cdot 10^5$ Pa. The vapor shall behave like an ideal gas.
b) Describing the vapor as a van-der-Waals gas, at which temperature does the vapor occupy the volume of part a)? Use a = 0.557 Pa $\cdot$ m^6/mol^2 and b = $31\text{cm}^3/\text{mol}$?

5) Winter in the student apartment
You want to heat your one-room-apartment. The room has a volume of 50 m^3. You opened the window in the morning and left it open. When you return in the evening, the room temperature is $T_0 = 5°\text{C}$ at a pressure of $p_0 = 1.0133 \cdot 10^5$ Pa. You want to heat to 20°C. Neglect the heat capacity of the walls.
a) The amount of air in the room is constant. Calculate the necessary thermal energy for heating. The specific heat of air is $c_V = 0.71$ kJ/(kg K) for a constant volume. (Use: 1 mole of air is 29 g.)
b) Your room is not airtight. Hence, air is leaking, and the pressure is constant during heating. Show that the inner energy of the air in the room does not change during heating.