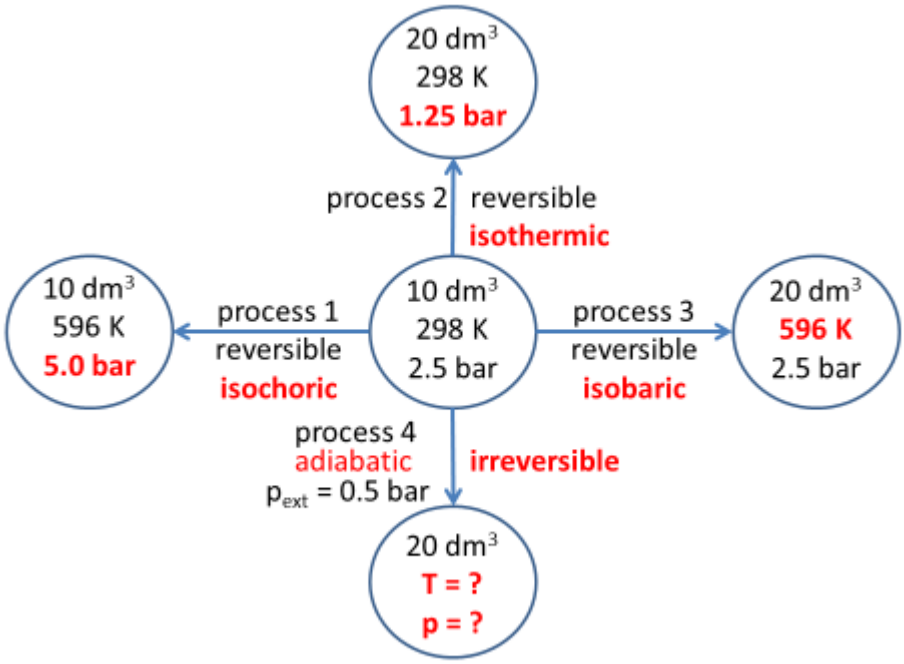
## Question 1

A cylinder containing 10 $dm^3$ of a monoatomic perfect gas at a pressure of 2.5 bar and a temperature of 298 K is subdued to 4 different processes as described in this scheme.




a) Derive a formula to calculate the exerted (volume)work $W$ for each of the four processes, using the formula: $W = -\int p\mathrm{d}V$

b) Derive a formula for each of the processes 1, 3 and 4 to calculate the heat $Q$.

c) Derive a formula for each process to calculate the internal energy $\Delta U$.

d) Derive the change of entropy $\Delta S$ for the processes 1, 2 and 3 using:
$\mathrm{d}S = \mathrm{d}Q_{rev} / T$

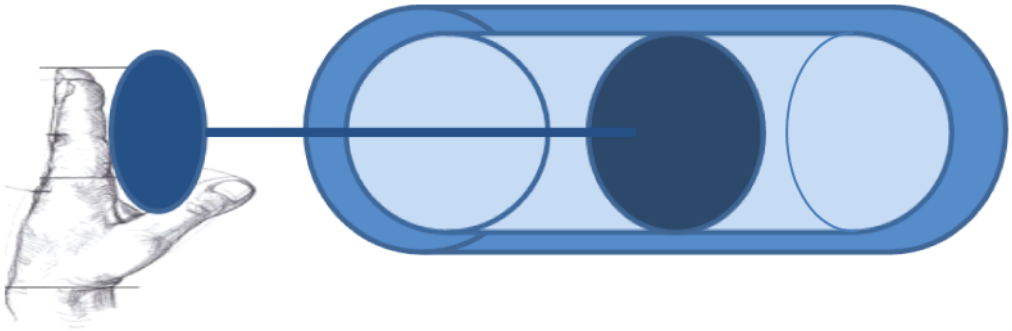
e) How could you calculate the change of entropy $\Delta S$ for process 4?

| Nr | kind of process | $W$ | $Q$ | $\Delta U$ | $\int \mathrm{d}Q_{rev}/T$ | $\Delta S$ |
|---|---|---|---|---|---|---|
| **1** | isochoric | | | | | |
| **2** | isothermic | | | | | |
| **3** | isobaric | | | | | |
| **4** | adiabatic | | | | **XXXXXXXXX** | |

## Additional material:

## Question 2

We could perform process 4 in the following manner: We take an isolated cylinder with a frictionless piston. On the right hand of the piston there is a monoatomic perfect gas, $p$ = 2.5 bar, and on the left of the piston there is a $p_{ext}$ = 0.5 bar.
The initial temperature of the gas is 298 K. Both compartments measure 10 $dm^3$.



After withdrawing the hand, the piston moves to its maximum volume: 20 $dm^3$.

a) Calculate the number of moles of the gas, present in the cylinder.
b) Calculate the temperature and the pressure when the maximum volume is reached. Use $\Delta U = -p_{ext}\Delta V = 3/2 nR\Delta T$.
c) Calculate the change of entropy, $\Delta S$, of the system.