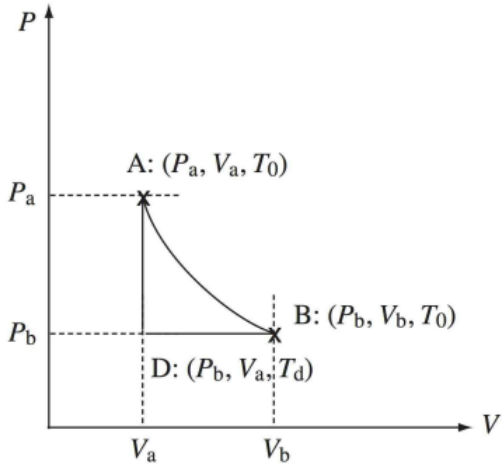
# General Physics II: Tutorial Material

## Lecture 7 (Mock Exam I)

**1)** A steel wire is wrapped over a block of ice with two heavy weights attached to the end of the wire. The wire passes through a block of ice without cutting the block in two. The ice melts under the wire and the water freezes again above the wire. The wire is considered a rigid rod of negligible mass lying on the ice block with an area of contact $A$. The two weights of mass $M$ each are hanging at both ends of the wire. The entire system is at atmospheric pressure $P_0$ and the ice is held at a temperature $T_m - dT$ where $T_m$ is the melting temperature at atmospheric pressure. The latent heat of melting of ice is $L$, the molar volume of water $v_l$ and the molar volume of ice $v_s$. Determine the minimal mass $M$ of each weight for this experiment to succeed, i.e., for the wire to pass through the ice block.

**2)** Let us consider an isothermal change of the state $A(V_A, P_A, T_0) \to B(V_B, P_B, T_0)$ in a closed system, where $V_A < V_B$.

1. Calculate the work and heat exchange of the system taking this path.
2. The system now takes another path from $A$ to $B$, namely an isovolumetric process from $A$ to $D$ first, followed by an isobaric process from $D$ to $B$. Calculate the work and heat for the two processes. Is the total heat of the path equal to the total work of the path? Is the result expected, and why?




**3)** Work as a process-dependent Quantity: three processes are performed on a gas from a state given by $P_1, V_1$ to a state given

1. an isochoric process followed by an isobaric process

2. an isobaric process followed by an isochoric process
3. a process where PV remains constant.

Compute for the three processes the work performed on the gas from the initial to the final state. Determine the analytical results first, and then give numerical values in Joules ($P_1 = P_0 =$ 1bar; $V_1 = 3V_0$; $P_2 = 3P_0$; $V_2 = V_0 =$ 1l).

**4)** Special exercise: Breaking of Copper due to cooling
Let's imagine we heat a piece of a copper pipe to 300°C and fasten it tightly at the ends so that it can't contract upon cooling. The tensile strength (=maximum stress a material can withstand while being stretched or pulled before breaking) of copper is 230 MN/m$^2$, and the Yung's modulus E for Copper is 110 GN/m$^2$. At what temperature will the pipe break as it cools down?