Exam practice exercise 1

Sunday, 10 May 2020 16:32

$V_1 = \frac{2L}{4 \text{ gaz moles}} = 0{,}5L$

$\frac{V_1}{V_2} = 18 \Rightarrow V_2 = \frac{V_1}{18} = \frac{1}{36}L \approx 0{,}028L$

$\frac{V_3}{V_2} = 2 \Rightarrow V_3 = 2V_2 = \frac{1}{18}L = 0{,}056L$

$V_4 = V_1 = 0{,}5L$ because there is an isochoric process from $V_4$ to $V_1$

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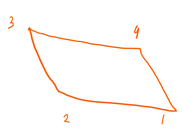
ideal gas : $PV = nRT$

~~$1 \to 2$ $dQ = 0$~~

~~$dU = dW$~~




~~$4 \to 1$ $dQ = nC_v\,dT$~~

~~$dW = PdV = \frac{nRT}{V}dV = 0$ because $dV = 0$~~

~~$dU = dQ - dW = dQ = nC_v\,dT$~~

$PV^{\gamma} = \text{constant}$ for adiabatic process

$\gamma = \frac{C_p}{C_v} = \frac{\frac{7}{2}R}{\frac{5}{2}R} = \frac{7}{5}$

$P_2 V_2^{\frac{7}{5}} = P_1 V_1^{\frac{7}{5}}$

$P_2 = P_1 \left(\frac{V_1}{\frac{1}{18}V_1}\right)^{\frac{7}{5}} = 18^{\frac{7}{5}} P_1 = 57{,}2 \text{ bar}$

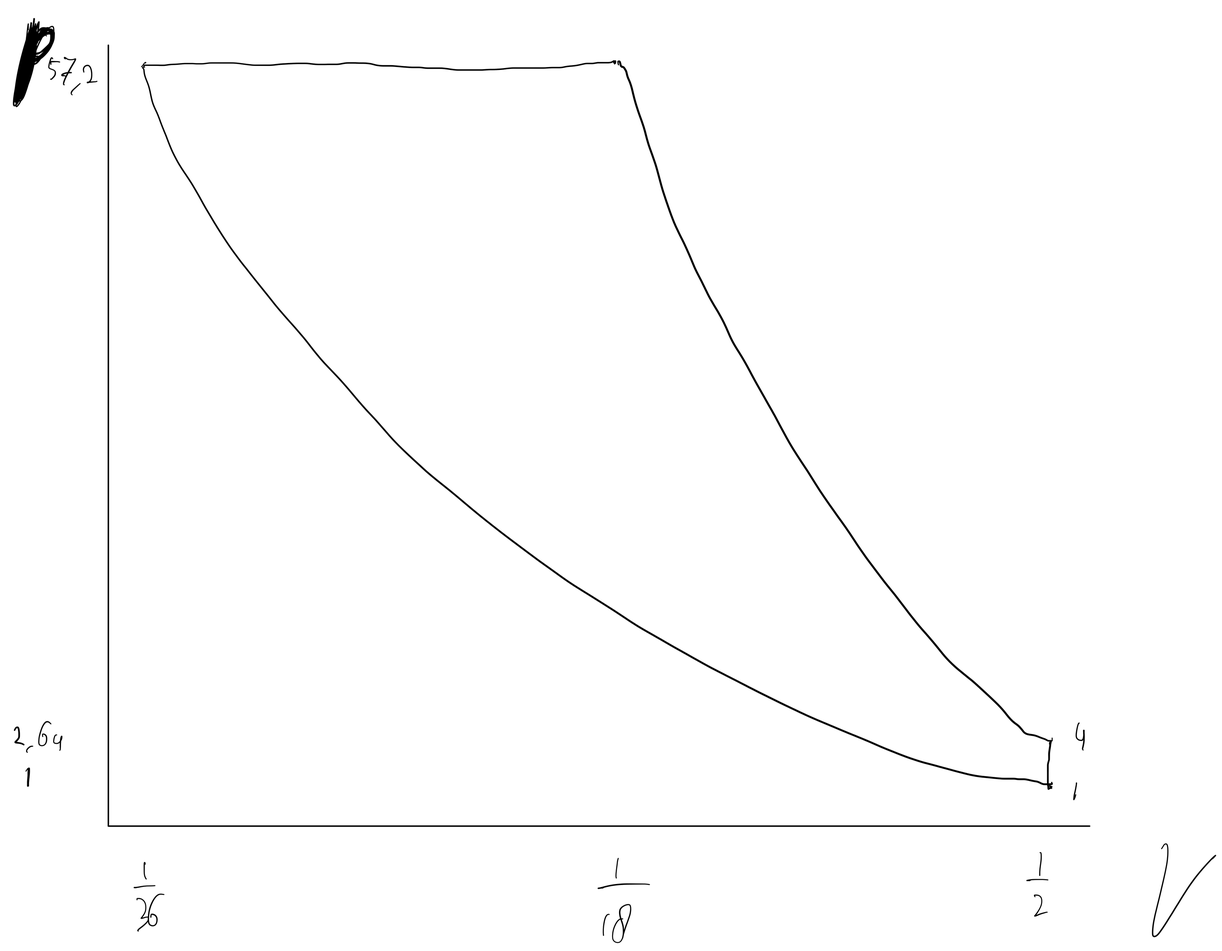
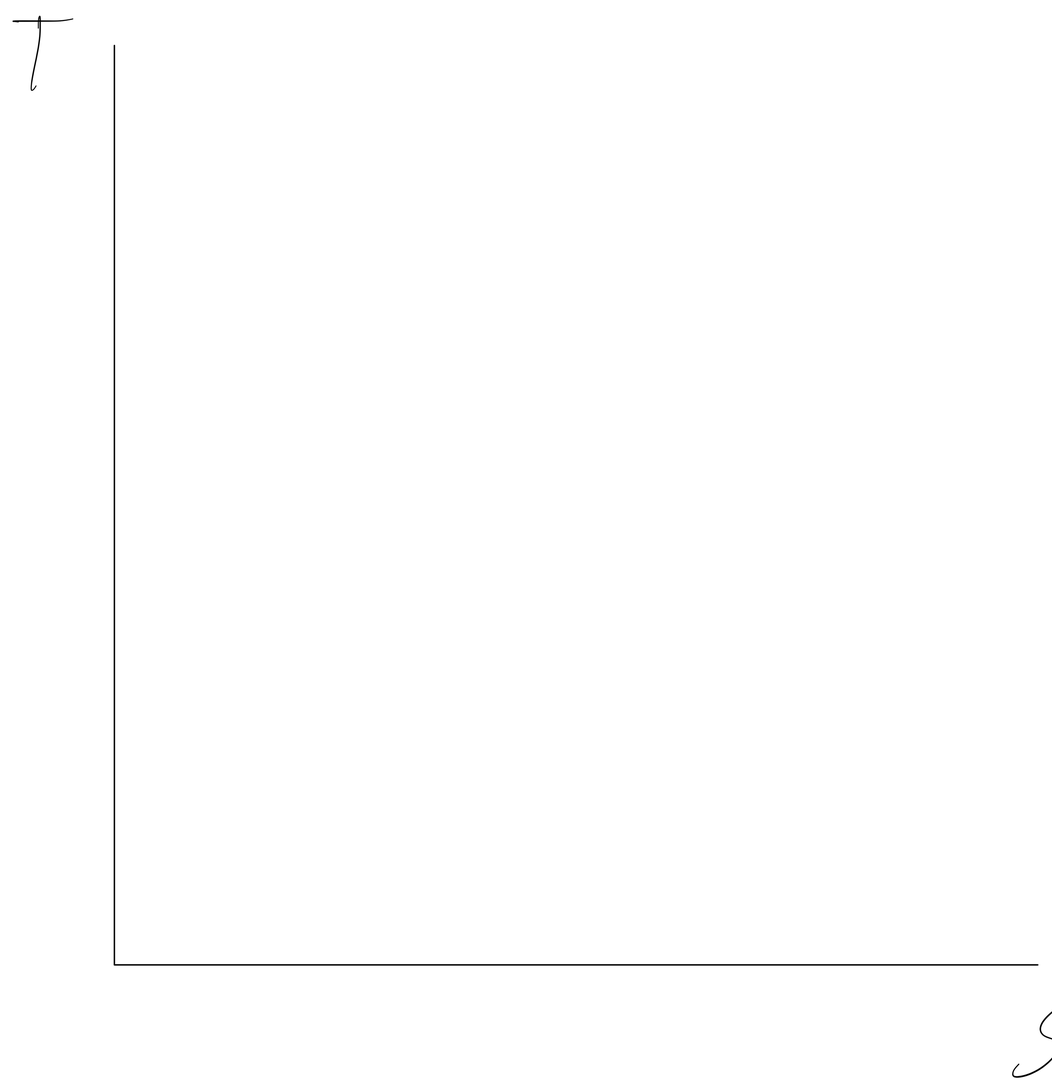
$n = \frac{P_1 V_1}{RT_1} = 20{,}8g$

$T_2 = \frac{P_2 V_2}{nR} = \frac{57{,}2 \cdot 10^5 \cdot 0{,}028}{20{,}8g \cdot 8{,}3145} = 915 K$

$P_3 = P_2 = 57{,}2$ bar (isobaric process)

$T_3 = \frac{P_3 V_3}{nR} = \frac{57{,}2 \cdot 10^5 \cdot \frac{1}{18}}{20{,}8g \cdot 8{,}3145} = 1830 K$

$3 \to 4$ $PV^{\gamma} = \text{constant}$

$P_4 = P_3 \left(\frac{V_3}{V_4}\right)^{\gamma} = 57{,}2 \cdot 10^5 \cdot \left(\frac{\frac{1}{18}}{\frac{1}{2}}\right)^{\frac{7}{5}} = 57{,}2 \cdot 10^5 \cdot \left(\frac{1}{9}\right)^{\frac{7}{5}} = 2{,}64 \cdot 10^5 \text{ Pa} = 2{,}64 \text{ bar}$

$T_4 = \frac{P_4 V_4}{nR} = \frac{2{,}64 \cdot 10^5 \cdot \frac{1}{2}}{20{,}8g \cdot 8{,}3145} = 760 K$