Računske n.:

1. Izpit KemTD-K1 (28.02.2011)

(2'99) 1.) $W_{min} = W_{rev}$ 0'25, $dW = -P_o dV$ 0'5 $= -PdV \Rightarrow W_{rev} = -\int_{V_1}^{V_2} PdV$ 0'5 $= -nRT \ln\frac{V_2}{V_1}$ 0'5 $= -\frac{m}{M}RT\ln\frac{V_2}{V_1}$ 0'25 $= -\frac{1000g}{28 g mol^{-1}} \cdot 8.314 J mol^{-1}K^{-1} \cdot 300K \cdot \ln\frac{0.1\ell}{1\ell}$ 0'25

$\underline{W = 205 kJ}$ 0'25

(2'50) 2.) $dQ = 0$; $dQ = dQ_1 + dQ_2$ 0'5 $\Rightarrow -dQ_1 = dQ_2$ $-nC_p\int_{T_1}^{T} dT = n\cdot C_p\int_{T_2}^{T} dT \Rightarrow -nC_p(T-T_1) = nC_p(T-T_2) \Rightarrow T = \frac{T_1+T_2}{2} = 323.75K$ 0'5

$dS = dS_1 + dS_2$ 0'25 $\Rightarrow \int_{T_1}^{T}\frac{nC_p}{T}dT + \int_{T_2}^{T}\frac{nC_p}{T}dT$ 0'5 $= nC_p\left[\ln\frac{T}{T_1} + \ln\frac{T}{T_2}\right]$ 0'5 $= n\cdot C_p \cdot \ln\frac{T^2}{T_1\cdot T_2} = 0.5 mol \cdot 77 J mol^{-1}K^{-1} \cdot \ln\frac{323.75^2 K^2}{373.15\cdot 273.15 K^2}$

$\underline{\Delta S = 0.93 JK^{-1}}$ 0'25

(2'50) 3.) $\frac{d\ln P}{dT} = \frac{\Delta H}{RT^2}$ 0'25 $\Rightarrow \ln\frac{P_2}{P_1} = -\frac{\Delta H}{R}\cdot\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$ 0'5 $\Rightarrow P_2 = P_1\cdot e^{-\frac{\Delta H}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)} = 1 atm \cdot e^{+\frac{42.76 kJ mol^{-1}}{8.314\cdot 10^{-3} kJ mol^{-1}K^{-1}}\cdot\left(\frac{1}{373.15} - \frac{1}{298.15}\right)}$ 0'25

$P_2 = 0.02325 atm$ 0'25 $P_1\cdot V = n_1RT_1$ $P_2\cdot V = n_2RT_2$ 0'5 $\Rightarrow \frac{P_1}{P_2} = \frac{n_1}{n_2}\cdot\frac{T_1}{T_2} \Rightarrow n_2 = n_1\cdot\frac{P_2}{P_1}\cdot\frac{T_1}{T_2} = 0.0296 mol$ 0'25

(2'50) $n_t = n_1 - n_2 = [1 - 0.0296] mol = 0.9704 mol$ 0'25 $\Rightarrow m = M\cdot n_t = 18 g mol^{-1} \cdot 0.9704 mol = \underline{17.47 g}$ 0'25

4.) $K_a = \frac{a_{NO_2}^2}{a_{N_2O_4}}$ 0'25 $\approx \frac{\frac{P_{NO_2}^2}{P^{\ominus 2}}}{\frac{P_{N_2O_4}}{P^\ominus}} = \frac{P_{NO_2}^2}{P_{N_2O_4}}\frac{1}{P^\ominus} = \frac{x_{NO_2}^2\cdot P^2}{x_{N_2O_4}\cdot P\, P^\ominus} = \frac{x_{NO_2}^2}{x_{N_2O_4}}\cdot\frac{P}{P^\ominus}$ 0'25 ; $\underline{P^\ominus = 1 atm}$

$K_p = \frac{x_{NO_2}^2}{x_{N_2O_4}}\cdot\frac{P}{P^\ominus}$; $K_p \approx K_a = e^{-\frac{\Delta G^\ominus}{RT}}$ 0'5 $= e^{-\frac{600 J mol^{-1}}{8.314 J mol^{-1}K^{-1}\cdot 298.15K}} \underline{= 0.785}$ 0'5

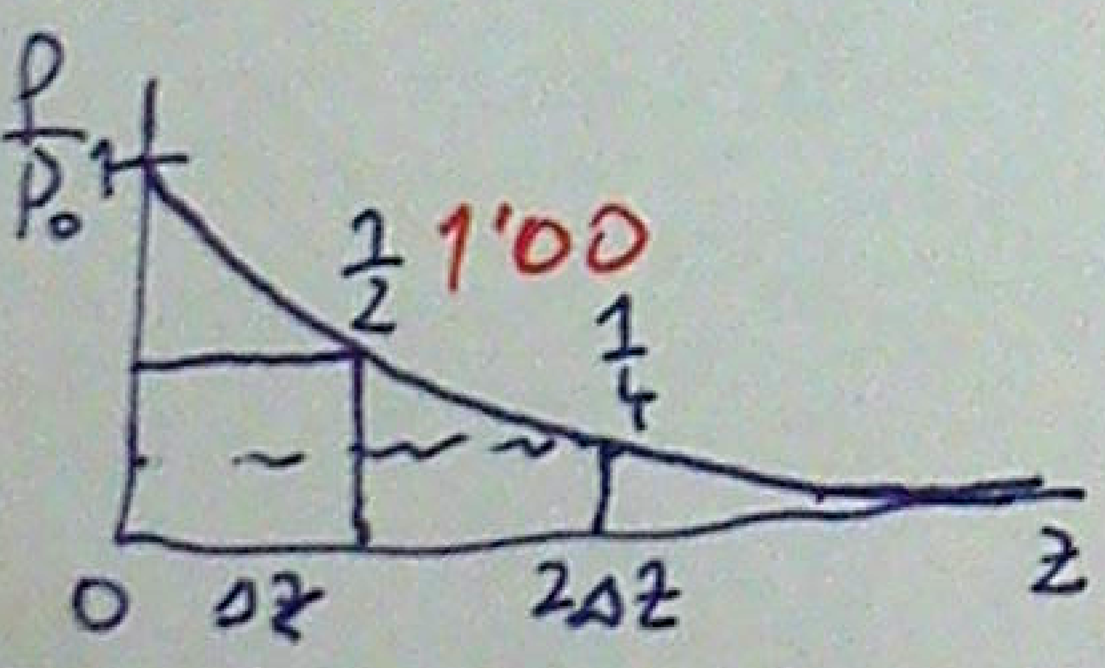
$N_2O_4 \rightleftarrows 2NO_2$

$n_0(1-\alpha)$ $\quad n_0 2\alpha$ $\Rightarrow \sum_i n_i = n_0\cdot(1+\alpha)$ 0'25 $\Rightarrow x_{NO_2} = \frac{2\alpha}{1+\alpha}$, $x_{N_2O_4} = \frac{1-\alpha}{1+\alpha}$ 0'25 $\Rightarrow K_p = \frac{\left(\frac{2\alpha}{1+\alpha}\right)^2}{\left(\frac{1-\alpha}{1+\alpha}\right)}\cdot\frac{P}{P^\ominus}$

$\alpha = 0.5 \Rightarrow K_p = \frac{1}{1.5\cdot 0.5}\cdot\frac{P}{P^\ominus}$ 0'25 $= \frac{1}{0.75}\cdot\frac{P}{P^\ominus} \Rightarrow P = 0.75 P^\ominus\cdot K_p = 0.75\cdot 0.785\cdot 1 atm \underline{= 0.589 atm}$ 0'25

Teoretične n.:

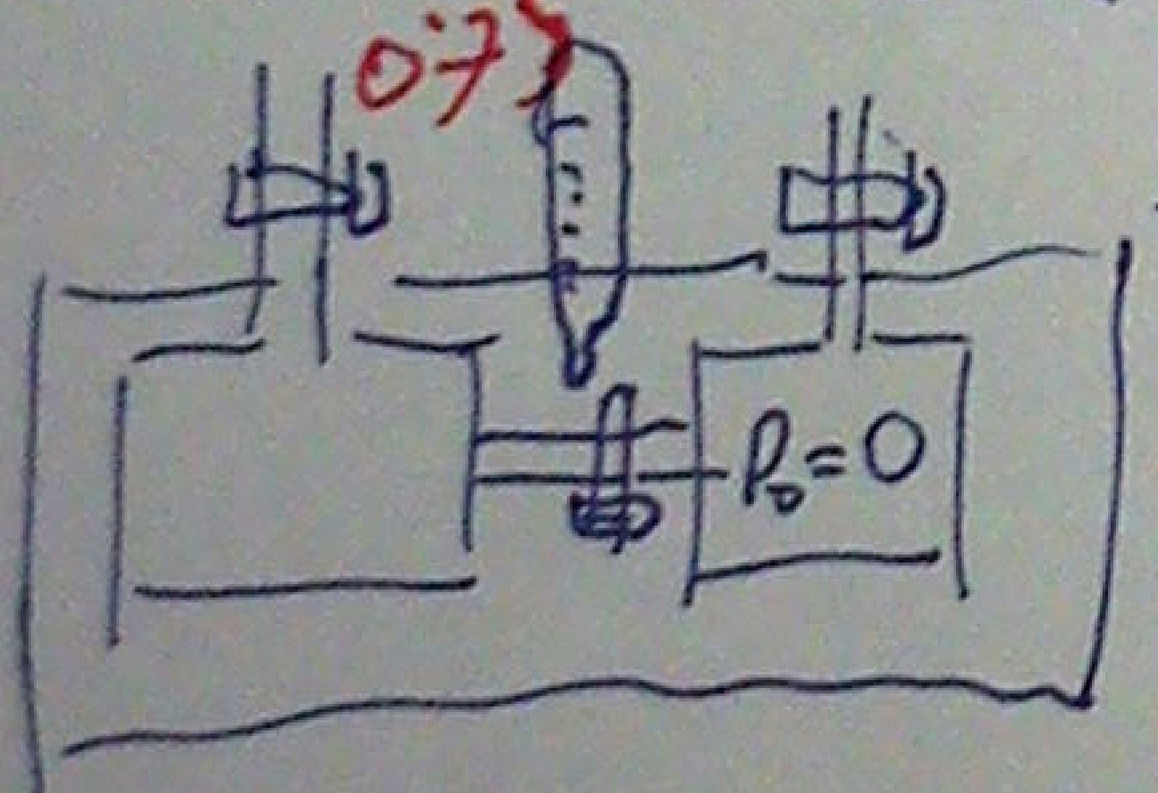
(2'50) 1.) $P = P_0\cdot e^{-\frac{Mgz}{RT}}$ 1'00



$M\uparrow \Rightarrow$ hitreje pada P z višino $\Rightarrow$ He, Ne v višjih pasteh atm. 0'25

$T\uparrow \Rightarrow$ počasneje pada P z višino 0'25

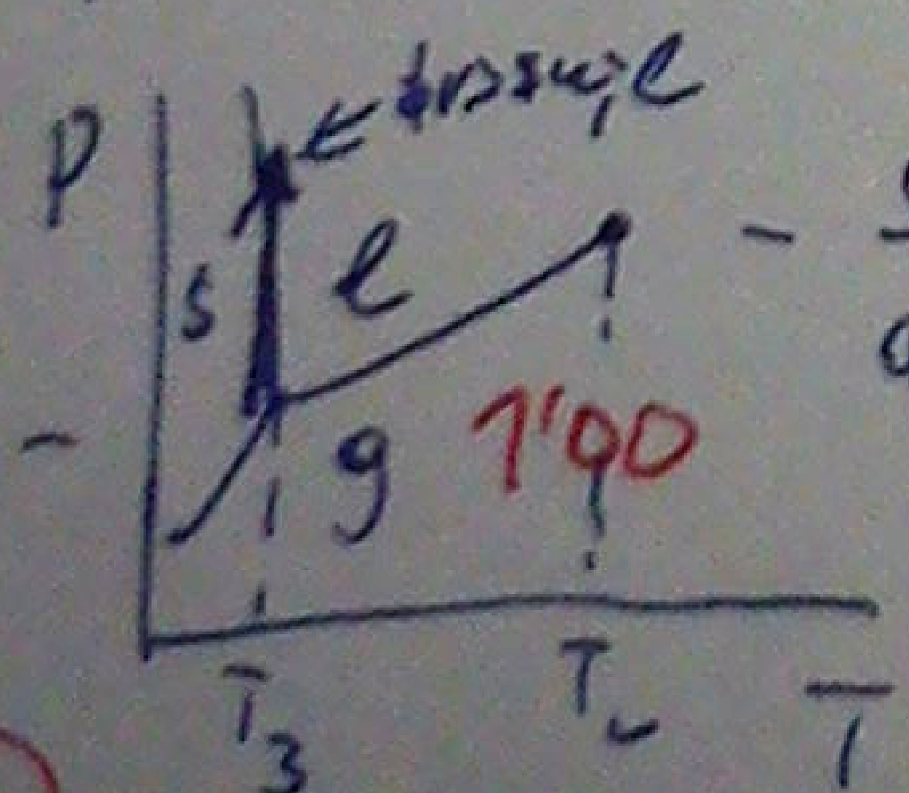
2.)



$-P_o = 0 \Rightarrow dW = -P_o dV = 0 \Rightarrow W = 0$ 0'25
izmerjen $\Delta T = 0$ 0'25 $\Rightarrow Q = 0$ } I. zakon TD $dU = dQ + dW = 0$ 0'25 $\quad dU = \left(\frac{\partial U}{\partial V}\right)_T dV + \left(\frac{\partial U}{\partial T}\right)_V dT$

$dU = \left(\frac{\partial U}{\partial V}\right)_T dV$ 0'25 $\Rightarrow \left(\frac{\partial U}{\partial V}\right)_T = 0$ (natančno samo za id. plin) - notranji tlak 0'25 (nenatančnost zaradi velike top. kap. vode $\Rightarrow$ nenatančno merjenje ΔT) 0'25

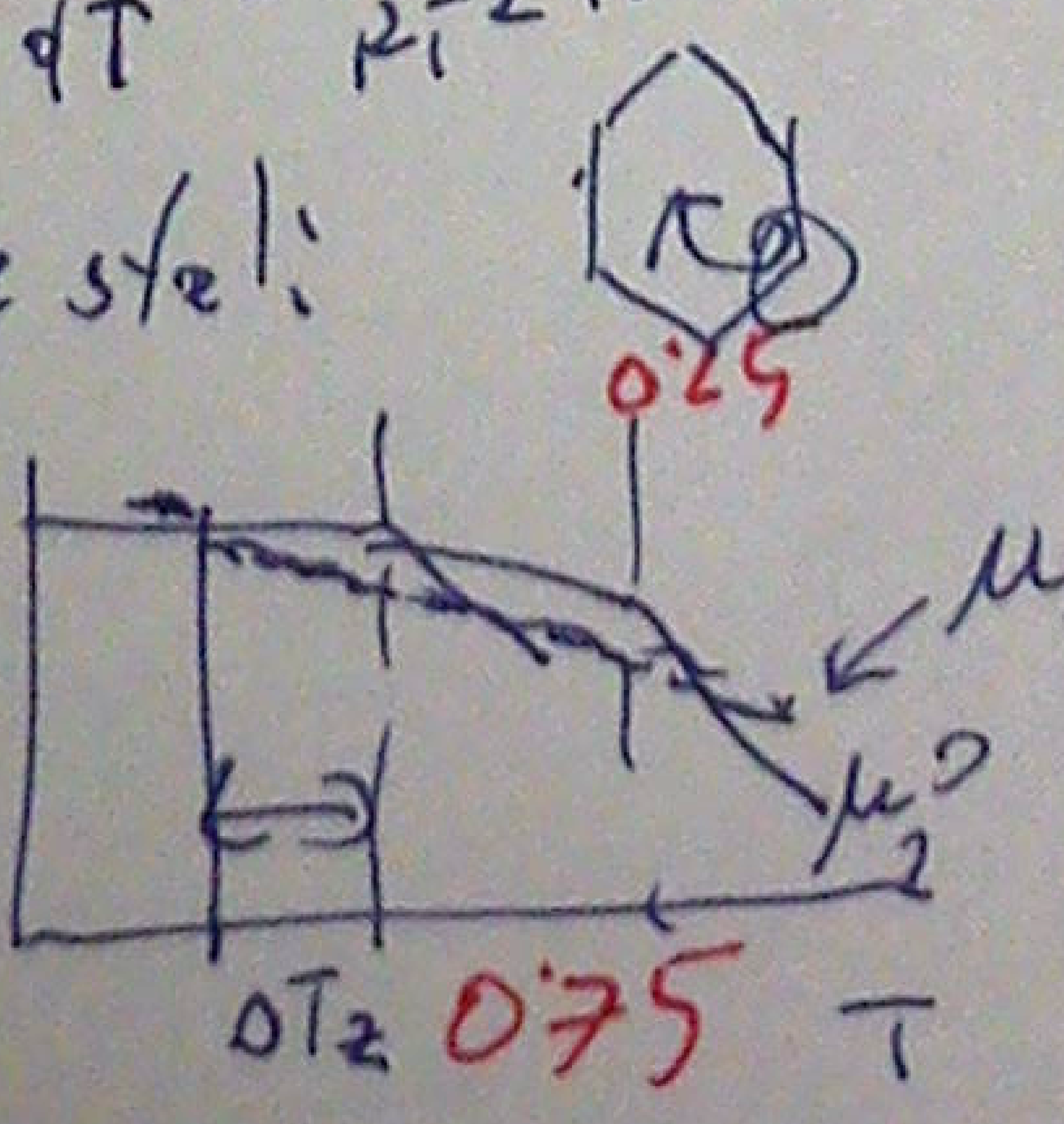
(2'50) 3.)



$-\frac{dP}{dT} = \frac{\Delta S^\circ}{\Delta V} = \frac{\Delta H^\circ}{T\Delta V}$ 0'5 $\overset{\text{izpeljava}}{\Rightarrow} \frac{d\ln P}{dT} = \frac{\Delta H^\circ}{RT^2}$ (para = id. plin, $\Delta V^\circ = V^\circ_{para}$) 0'5

- drsanje $P\uparrow \Rightarrow$ led se stali! 0'25

(2'50) 4.) $\mu_1 = \mu_1^\circ + RT\ln x_1$ 0'5 $\Rightarrow \mu_1 < \mu_1^\circ$ 0'5



$\Rightarrow \Delta T_z = K_z\cdot m$, $m_2 = \frac{n_2}{m_1 M_1}$ 0'25

- določanje M_2 (zmrzišče + ΔT_z) 0'5