

1) Se la reazione di <sup>de</sup>idrogenazione dell'etano  $[CH_3-CH_3 \rightarrow CH_2=CH_2 + H_2]$  a 300 K ha  $\Delta H^\circ = 102,17 \text{ kJ/mol}$  e  $\Delta G^\circ = 22,38 \text{ kJ/mol}$  calcola  $K_p$  a 2000 K se  $\Delta H^\circ$  è costante.

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ = -RT \ln K_p \quad \ln K = -\frac{\Delta H^\circ}{RT} + \frac{\Delta S^\circ}{R} \quad \frac{d \ln K}{dT} = -\frac{d}{dT} \left( \frac{\Delta H^\circ}{RT} - \frac{\Delta S^\circ}{R} \right)$$

$$\frac{d \ln K}{dT} = \frac{\Delta H^\circ}{RT^2} \quad \int_{K_1}^{K_2} d \ln K = \frac{\Delta H^\circ}{R} \int_{T_1}^{T_2} \frac{dT}{T^2} \quad \text{integrando} \quad \boxed{\ln \frac{K_2}{K_1} = \frac{\Delta H^\circ}{R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right)}$$

$K_1$  si ricava dalle  $\Delta G^\circ = -RT \ln K_p \quad \ln K_p = -\frac{\Delta G^\circ}{RT} \quad \ln K_1 = \frac{-22,38 \cdot 10^3 \text{ J/mol}}{8,31 \cdot 300 \text{ K}}$

$K_1 = 5,017 \cdot 10^{-2}$

$\ln \frac{K_2}{K_1} = \frac{102,17 \cdot 10^3}{8,31} \left( \frac{1}{300} - \frac{1}{2000} \right) = 12,295 \cdot 10^3 \left( 1,111 \cdot 10^{-3} - 0,5 \cdot 10^{-3} \right) = 7,514$

$\frac{K_2}{K_1} = 1833 \quad K_2 = 1833 \cdot 5,017 \cdot 10^{-2} = \boxed{91,95 \text{ Pa}} \quad K_2$

2) Il calore latente di evaporazione di  $H_2O$  a  $100^\circ\text{C}$  e 1 atm è  $40,67 \text{ kJ/mol}$ . Calcola la temperatura di ebollizione dell' $H_2O$  a 540 mm Hg.

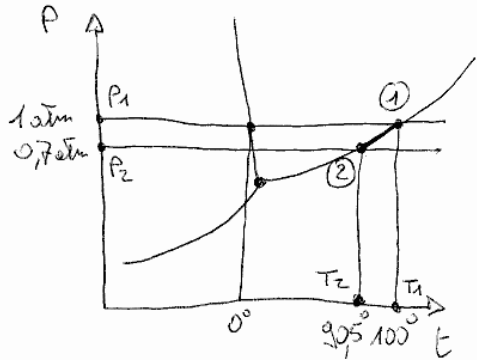
$P_2 = \frac{540}{760} = 0,7105 \text{ atm}$

$\frac{\Delta P}{\Delta T} = \frac{\Delta H_{ev}}{T \Delta V}$

$\frac{\Delta P}{\Delta T} = \frac{\Delta H}{T V_{gas}} = \frac{\Delta H}{T} \frac{P}{RT}$

$\frac{\Delta P}{\Delta T} = \frac{\Delta H P}{RT^2}$  separo le variabili  $\frac{\Delta P}{P} = \frac{\Delta H}{R} \frac{\Delta T}{T^2} \quad \int_{P_1}^{P_2} \frac{dP}{P} = \frac{\Delta H}{R} \int_{T_1}^{T_2} \frac{dT}{T^2}$

$\ln \frac{P_2}{P_1} = \frac{\Delta H}{R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right) \quad \left( \frac{1}{T_1} - \frac{1}{T_2} \right) = \ln \frac{P_2}{P_1} \frac{R}{\Delta H} \quad \frac{1}{T_2} = \frac{1}{T_1} - \ln \frac{P_2}{P_1} \frac{R}{\Delta H}$



$T_1 = 373 \text{ K} \quad P_1 = 1 \text{ atm} \quad P_2 = 0,7105 \text{ atm} \quad \Delta H_{ev} = 40,67 \cdot 10^3 \text{ J/mol}$

$$\frac{1}{T_2} = \frac{1}{373} - \ln \frac{0,7105}{1} \frac{8,31}{40,67 \cdot 10^3}$$

$$\frac{1}{T_2} = 2,681 \cdot 10^{-3} + 0,3418 \cdot \frac{8,31}{40,67 \cdot 10^3}$$

$$\frac{1}{T_2} = 268,1 \cdot 10^{-5} + 6,984 \cdot 10^{-5}$$

$$\frac{1}{T_2} = 275,1 \cdot 10^{-5} \quad T_2 = 363,5 \text{ K} \quad \boxed{90,5^\circ\text{C}}$$

3) Se il Tempo di semivita di una sostanza che si decompone con una cinetica del 1° ordine è di 36 minuti, calcola quanti grammi ne rimangono dopo 3 ore e 5' partendo da 28 g di sostanza.

$$v = k[A] \quad v = -\frac{d[A]}{dt} \quad -\frac{dA}{dt} = kA \quad \int_{A_0}^A -\frac{dA}{A} = \int_{t_0}^t k dt \quad \ln \frac{A_0}{A} = kt$$

$$\frac{\ln \frac{A_0}{A}}{t} = k \quad \frac{\ln \frac{A_0}{A_1}}{t_1} = \frac{\ln \frac{A_0}{A_2}}{t_2} \quad \frac{\ln 2}{t_{\frac{1}{2}}} = \frac{\ln \frac{A_0}{A_2}}{t_2} \quad \left[ \ln \frac{A_0}{A_2} = \frac{\ln 2 \cdot t_2}{t_{\frac{1}{2}}} \right]$$

$$A_0 = 28 \text{ g} \quad A_2 = ? \quad t_2 = 3 \cdot 3600 + 5 \cdot 60 = 11100 \text{ s.} \quad t_{\frac{1}{2}} = 185 \text{ min} \quad t_1 = 36 \text{ min}$$

$$\ln \frac{A_0}{A_2} = 0,693 \cdot \frac{11100}{36} = 3,562 \quad \frac{A_0}{A_2} = 35,23 \quad A_2 = \frac{28}{35,23} = 0,795 \text{ g}$$

$$\boxed{A_2 = 0,80 \text{ g}}$$