EXERCISES #7 Name : ______________________________

Assignment date: 16th December 04
Hand back before: 7th January 05 (midday)
Discussion: 8th January 05

1. Calculate the equilibrium constant of the reaction 2 H_2S (g) + SO_2 (g) ⇆ 2 H_2O (g) + 3 S (s) at 25 °C, knowing the following values of $\Delta_f G°$:

Compound	H_2O (g)	H_2S (g)	SO_2 (g)
$\Delta_f G°$ (298 K; kJ mol^{-1})	-228,59	-33,60	-300,19

[$K°$ = 5,39.10^{15}]

2. The standard enthalpy of the reaction N_2 (g) + 3 H_2 (g) ⇆ 2 NH_3 (g) at 25 °C equals –92,4 kJ/mol. Standard molar entropies of individual compounds are following:

Compound	N_2 (g)	H_2 (g)	NH_3 (g)
$S°$ (298 K; J mol^{-1} K^{-1})	191,58	130,67	192,59

Calculate the equilibrium constant of the reaction at 25 °C.

[$K°$ = 6,67.10^5]

3. Estimate the temperature at which $CuSO_4.5\ H_2O$ undergoes dehydration.

Compound	H_2O (g)	$CuSO_4$ (s)	$CuSO_4.5H_2O$ (s)
$S_m°$ (J mol^{-1} K^{-1})	188,83	109,0	300,4
$\Delta_f H°$ (kJ mol^{-1})	-241,82	-771,36	-2279,7

[T = 397,5 K]

4. The dissociation vapor pressure of NH_4Cl at 427 °C is 608 kPa but at 459 °C it has risen to 1115 kPa. Calculate (a) the equilibrium constant, (b) the standard reaction Gibbs energy, (c) the standard enthalpy, (d) the standard entropy of dissociation, all at 427 °C. Assume that the vapor behaves as a perfect gas and that $\Delta S°$ and $\Delta H°$ are independent of temperature in the range given.

[a) $K°$ = 9,24; b) $\Delta_r G°$ = -12,94 kJ mol^{-1}; c) $\Delta_r H°$ = 161,49 kJ mol^{-1}; d) $\Delta_r S°$ = 249,18 J K^{-1} mol^{-1};]

5. Estimate $S°$ and $\Delta_f H°$ of 4-chloro-cyclohexanenitrile using Benson thermochemical tables.

[$\Delta_f H°$ = -8.72 kcal mol^{-1}; $S°$ = 93.9 cal K^{-1} mol^{-1};

6. Calculate the pH of (a) 0,10 M $NaHCO_2$ (aq), (b) 0,20 M C_6H_5COONa, (c) 0,150 M HCN (aq). pK_a (HCOOH) = 3,75; pK_a (PhCOOH) = 4,19; pK_a (HCN) = 9,31.

[a) 8,38; b) 8,75; c) 5,07]

Es gibt die erstaunliche Möglichkeit, dass man einen Gegenstand mathematisch beherrschen kann, ohne den Witz der Sache wirklich erfasst zu haben.

Albert Einstein

HAPPY XMAS

$\left(\frac{\partial[G/T]}{\partial(1/T)}\right)_p$; U-TS ; $-\left(\frac{\partial U}{\partial V}\right)_S$; $-\left(\frac{\partial A}{\partial V}\right)_T$; the mol fraction in the gas phase ; $\frac{PM}{p^*}$;

Gibs-Helmholtz   Helmholtz free E   P   P   Y   Xn

$\mu_i - \mu_i^\circ = RT \ln$ $e^{\left(\frac{\mu_s - \mu_s^\circ}{RT}\right)}$ as