CHEM352: Physical Chemistry I
Homework Set V - due 6^th of Dec, 5.00 pm

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Lecture: Tue, 2.10-3.25 pm & Fri 2.10-3.25 pm, **C111**
Office hours: Wed, 4-6 pm, **HN - 1321B**

Problem 1 — CH10/5Pts

At 298.15 K, the pKa for acetic acid is equal 4.8. Using Debye-Hückel limiting law and Davies equation, calculate the pH in 0.05 m and 1.00 m solutions. Which equation is more applicable to low concentration? Compare the calculated pH values with the situation when γ_{pm} is equal to 1.

Problem 2 — CH10/5Pts

Calculate the exent of hydrolysis of 0.3 m solution of dimethylamine ($K_b = 5.12 \cdot 10^{-4}$) in (a) pure water and (b) 1 m solution of potassium nitrate.

Problem 3 — CH11/5pts

1. Determine E° for the reaction:
$$Co^{2+}(aq) + 2e^- \rightarrow Co(s) \tag{1}$$
using one electron reduction and three electron reduction reactions of Co^{3+}.
2. Determine the activity of $Sn^{4+}(aq)$ in the following reaction at 298.15K at equilibrium:
$$Sn(s) + Sn^{4+}(aq) \rightleftarrows 2Sn^{2+} \tag{2}$$
The $a_{Sn^{2+}} = 0.25$.
3. Determine K_{sp} for $AgBr$ at 298.15K using the electrochemical cell descibed by:
$$Ag(s)|Ag^+(aq, a_{Ag^+})||Br^-(aq, a_{Br^-})|AgBr(s)|Ag(s) \tag{3}$$

You can find respective chemical potentials in Table 11.2 in the appendix or use your favorite web-search protocol.

Problem 4 — CH29/5pts

Consider Maxwell-Boltzmann velocity distribution in one dimentsion:

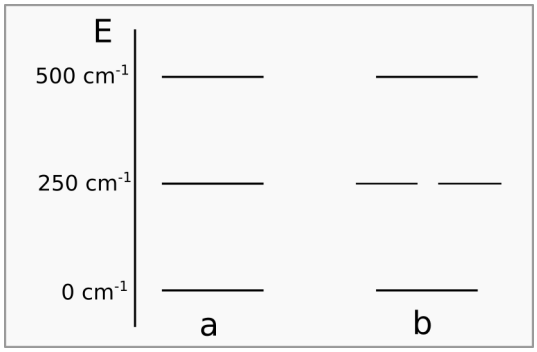
$$P(v)dv = C \cdot v^2 \cdot e^{-mv^2/2kT} dv \tag{4a}$$

1. Determine the normalization constant C
2. Deteremine $< v >$, $< v^2 >$ and the variance $< \sigma >^2 = < v^2 > - < v >^2$.
3. Determine the most probable velocity.

Solutions for respective integrals you can find in your favorite pchem or calculus books, web-search engine, or social-media channel.

Problem 5 — CH30/5pts

The figure below shows energy diagram for two model systems: (a) the system has three non-degenerate energy states available and (b) the system has three states available,one of them being doubly degenerate. At what temeprature the occupation of the second energy level is equal to 0.25?


E
500 cm-1
250 cm-1
0 cm-1
a
b