CHEM352: Physical Chemistry I
Homework Set VI - due $14^th$ 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: Thu, 4-6 pm, **HB - 1321B**

## Problem 1 CH32/5pts

A gas absorbed on a surface can sometimes be modelled as a two-dimensional ideal gas which partition fuction is given by:

$$Q(N, A, T) = \frac{1}{N!}\left(\frac{2\pi m k_B T}{h^2}\right)^N A^N \tag{1}$$

where A is the area of the surface. Derive the expression for $< E >$ and compare with the three-dimensional result. Calculate the heat capacity of 2-dimensional gas.

## Problem 2 CH32/5pts

Next, calculate the entropy of 2-dimensional ideal gas.

## Problem 3 CH32/5pts

In problem set V, you calculated partition function of $CO_2$ molecule in 1.0 $nm^3$ and 1000K. Now, please compute its energy and heat capacity and Gibbs energy. Please show the individual contributions to the gibbs energy.

## Problem 4 CH32/5pts

Detertmine the equilibriun constant for the sodium dissociation at 400K:

$$Na_{2(g)} \rightleftarrows 2Na_{(g)} \tag{2}$$

where B=0.155 $cm^{-1}$, $\bar{\nu}$ = 159 $cm^{-1}$ and dissociation energy is 70.4 kJ/mol, and ground-state energy-degeneracy is 2.

## Problem 5 CH32/5pts

The equilibrium constant for any isotope exchange reaction, like one given below:

$$^{35}Cl -^{35} Cl +^{37} Cl -^{37} Cl \rightleftarrows 2^{37}Cl -^{35} Cl \tag{3}$$

is approximately 4. Well... can you explain? Assume that rotational vibrational frequescies are roughly constant. (think about coins and micro vs macroscopic variables).