

CHEM352: PHYSICAL CHEMISTRY I  
HOMEWORK SET VI - DUE 14<sup>th</sup> 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 adsorbed on a surface can sometimes be modelled as a two-dimensional ideal gas which partition function is given by:

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

where A is the area of the surface. Derive the expression for  $\langle E \rangle$  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  $1.0 \text{ nm}^3$  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**

Determine the equilibrium constant for the sodium dissociation at 400K:

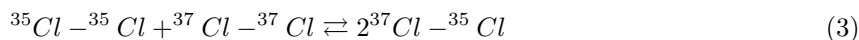


where  $B=0.155 \text{ cm}^{-1}$ ,  $\bar{\nu} = 159 \text{ cm}^{-1}$  and dissociation energy is 70.4 kJ/mol, and ground-state energy-degeneracy is 2.

**Problem 5**

**CH32/5pts**

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



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