

**Chemistry 301
Thermodynamics
Midterm Exam II
November 2, 2001**



Name _____

Full credit will be given to correct answers only when ALL the necessary steps are shown. DO NOT GUESS THE ANSWER.

This is a open book open notes exam, and you are responsible to be sure that your exam has no missing pages(7 pages). Please cite all sources of information used to solve this exam.

If you consider that there is not enough information to solve a problem, you have to specify the missing information and describe the problem solving procedure.

No one can make you feel inferior without your consent
- Eleanor Roosevelt -

Once you start the exam, you have up to 48 hours to solve it.

Starting time: _____

Ending time: _____

Exam is due Tuesday November 6th at 8:30am.

Honor Statement

Except from the instructor, you are not allowed to discussed with anybody any of the questions in this exam until November 6, 6:30 am 2001.

I have neither give nor received aid in this examination.

Full signature _____

Problem 1.- (25 points)

The heat capacity of lead varies with temperature as follows:

T/K	$C_p / \text{JK}^{-1} \text{mol}^{-1}$
10	2.8
15	7.0
20	10.8
25	14.1
30	16.5
50	21.4
70	23.3
100	24.5
150	25.3
200	25.8
250	26.2
298	26.6

Calculate the standard Third Law entropy of lead at

- 0 C
- and
- 25 C.

Problem 2.(25 points)

Consider the hydrolysis of ATP



At Standard conditions (concentrations equal to 1 Molar) and $T = 298 \text{ K}$, we have the following values:

$$\Delta G^\circ = 10.0 \text{ kJ}$$

$$\Delta H^\circ = 20.3 \text{ kJ}$$

$$\Delta S^\circ = 34.0 \text{ kJ}$$

Life does not like a proton concentration of 1M, but rather life is found at a $\text{pH}=7.00$. Thus we define a biochemist reference point where one considers $\text{pH}=7.00$. This reference brings some changes to ΔG° , and ΔH° ,

$$\Delta H^{\circ'} = \Delta H^\circ - \text{mol R T } 7.00 \ln(10)$$

$$\Delta G^{\circ'} = \Delta H^{\circ'} - T \Delta S^\circ$$

a) For the hydrolysis of ATP, calculate the values of ΔG° for $\text{pH } 6.00, 7.00$ and 8.00 and T equal to $25, 36$ and $42 \text{ }^\circ\text{C}$.

Problem 3. (25 points)

It is found that the vapor pressure of a particular liquid varies with temperature as

$$\log_{10}(P/\text{bar}) = -4849 \text{ K}/T - 14.70 \log_{10}(T/\text{K}) + 50.24$$

How does the heat of vaporization vary with temperature?

What is the heat of vaporization at 20 °C.

Problem 4. (25 points)

First read pages 82 and 83 in your textbook. The final result is a relation between T_s and V_s for a reversible adiabatic compression of a Perfect Gas. Now consider a Berthelot gas and find the relation between the T_s and V_s for a reversible adiabatic compression.

Bonus (10 points)(no partial credit)

Did you help during DEMO DAY ?

Yes = 10 Points

No = 0 Points