Chem 203
First Exam-Part B
Friday October 5, 1990

Name _____

R=8.314 J/K mol
=1.98 cal/K mol
=0.082 lt atm/K mol

Full credit will be given to correct answers only when ALL the necessary steps are shown.

This is an open book, open notes exam, and you are responsible to be sure that your exam has no missing pages(5 pages).

Once you start the exam, you will have 6 hours to solve it.

Start time: _____ End : _____

The exam is due Sunday October 7, 1990 at 3pm.

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.

Honor Statement

I have neither give nor received aid in this examination.

Full signature _____

Problem 1 Initially 0.1 mol of methane is at 1 atm pressure and 80 C. The gas behaves ideally and thge value of $C_P / C_V = 1.31$. The gas is allowed to expand revessibly and adiabatically to a pressure of 0.1 atm.

a) (10 points) What are the initial and final volumes of the gas?

b) (10 points) What is the final temperature?

c) (10 points) Calculate ΔU and ΔH fotr the process.

Problem 2 (30 points) If the molar heat capacity of reactants and products behaves as

$$C_P(\text{compound}) = a + bT + \frac{c}{T^2} \ .$$

Deduce an expression for the enthalpy of the reaction T in terms of its enthalpy at 25 C and three coefficients. Estimate the error involved in ignoring the temperature variation of C_P for the formation of water at 1000 C.

Problem 3 (30 points) The heat capacity of lead varies with temperature as follows:

T/K	C_p /JK^{-1} 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 a) 0 C and b) 25 C.

Problem 4 (20 points) Suppose that the isothermal compressibility of a solid, defined by

$$\kappa_T \equiv -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T \quad ,$$

is a constant independent of V and T.

Write down an equation of state for the solid valid for not too high pressure and constant temperature in terms of κ_T and the volume V_o (V=.V_o when P= 1 atm) . Calculate the work done in increasing the pressure quasi-statically and isothermally on a solid from V_1 to V_2 . Apply this formula to calculate the work done when 10 g of copper is subjected to a pressure increase from 1 atm to 1000 atm at 0 °C. For copper we have ρ = 8.93 g/cm^3 and $1/\kappa_T$ = 1.31 x 10^{12} dyn/cm^2 at 0 °C.