Chemistry 301
Thermodynamics
Midterm Exam
Part A
October 6, 1993

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 closed book and closed notes exam, and you are responsible to be sure that your exam has no missing pages(6 pages).

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.

Whoever thinks a faultless
piece to see
Thinks what ne'er was, nor is,
nor e'er shall be.

- Alexander Pope,
An Essay on Criticism

"***Contrariwise***", ***continued Tweedledee,*** "***if it was so, it might be; and if it were so, it would be, but as it isn't, it ain't. That's logic!***"

- Lewis Carol,
Through the Looking Glass

Honor Statement

I have neither give nor received aid in this examination.

Full signature _______________________________

Problems 1-2. According to the kinetic theory of gases the translational kinetic energy of a monatomic gas is given by

$$U = \frac{3}{2}\ n R T,$$

where n is the number of moles of gas.

Problems 1 (15 points)

Compute ΔU and ΔH when the temperature of 2.00 mol of ideal gas is increased from 300K to 600K.

a) $\Delta U = 0$; $\Delta H = 0$.
b) $\Delta U = 3.75$ kJ, $\Delta H = 6.25$ kJ.
c) $\Delta U = 5$ kJ, $\Delta H = 10$ kJ.
d) $\Delta U = 7.5$ kJ, $\Delta H = 12.5$ kJ.
e) $\Delta U = 10$ kJ, $\Delta H = 15$ kJ.

Problems 2 (15 points)

Compute ΔU and ΔH when the pressure on 2.00 mol of ideal gas is increased from 2.00 atm to 4.00 atm at 300K.

a) $\Delta U = 0$; $\Delta H = 0.$ kJ
b) $\Delta U = 3.75$ kJ, $\Delta H = 6.25$ kJ.
c) $\Delta U = 5.0$ kJ, $\Delta H = 10$ kJ.
d) $\Delta U = 7.5$ kJ, $\Delta H = 12.5$ kJ.
e) $\Delta U = 10$ kJ, $\Delta H = 15$ kJ.

Problem 3 (20 points)

Derive an expression for

$$(\partial V/\partial T)_{P\ n}$$

for an ideal gas. Evaluate the constant pressure expansion coefficient

$$\alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_{P\ n}$$

for an ideal gas at 0˚C and 1 atmosphere pressure.

a) 0
b) 0.00366/K
c) 3.66/K
d) 273/K
e) ∞

Problem 4

Consider 1 mole of an ideal gas in an engine undergoing the following cycle:

i) Isothermal reversible expansion from 5 L to 10 L at T = 100 ˚C.
ii) Constant volume cooling to T = 0 ˚C.
iii) Isothermal reversible compression from 10L → 5L at T = 0 ˚C.
iv) Constant volume heating to T = 100 ˚C.

a) (10 points) Sketch the cycle in P-V space.

b)(20 points) Calculate net work gained by the surroundings.

c)(20 points) Calculate the heat absorbed by the system.

If therefore angels are not composed of matter and form, as was said above, it follows that it would be impossible to have two angels of the same species
... The motion of an angel can be continuous or discontinuous as it wishes ...
And thus an angel can be at one instant in one place, and at another instant in another place, not existing at any intermediate time.
 - Thonas Aquinas (1268)

If you know a thing, it is simple; if it is not simple, you do not know it
 - Oriental Proverb