

Chemistry 21c (AY 2007-08)  
Midterm Examination- Closed Book Section  
Distributed: May 02, 2008  
Due: May 08, 2008, 12:00 pm (at noon)

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## PART 1 - CLOSED BOOK - 25 POINTS

Directions:

This portion of the examination must be taken in a continuous time period of **1 hour**. Do not open the exam until you are ready to take it. Once you open the exam, the clock starts. After 1 hour, stop working and do not return to this section of the exam. You will not be given points for “over-time” work. You may not carry over unused time to the open book section. Do not discuss the exam with classmates until after the submission time. You must complete the closed book section BEFORE moving onto the open book section.

Exams should be placed in the Ch21c mailbox (first floor of Noyes) **no later than Thursday, May 8 at 12:00pm**. Late examinations will not be accepted without a Dean’s excuse.

**There are 6 questions on this section of the examination.** You must answer all of the questions in order to receive full credit.

Allowed Materials:

- Your brain, paper, and a pen. You may not use notes, textbooks, calculators, slide rules, trumpets, etc.

**Do not open this examination until you are ready to begin working. You will have 1 hour from when you open this exam to finish working on it. After finishing this section, move on to the open book section.**

1	2	3	4	5	6	7	TOTAL

**GOOD LUCK!!!**

Closed Book Questions - 1 hour - 25 points

- 1) In our derivation of kinetic molecular theory, what assumptions did we make about the physical description of a perfect gas? Explain how a real gas equation of your choice corrects for non-ideality. (4 points)
- 2) A pyroelectric crystal is very useful as an infrared sensor. When it absorbs heat from a radiation source, the electric dipole moments of the unit cells reorient to change the potential across the crystal faces. This potential can then do electrical work. As a result, it converts heat into work. This appears to violate the Kelvin statement of the Second Law. Explain what must happen to avoid this. (4 points)
- 3) Explain (physically and mathematically) why we do not write  $\Delta q$  and  $\Delta w$ . (4 points)
- 4) Write out descriptions of the zeroth, first, and second laws of thermodynamics. If you choose to write equations, be sure to explain them. (4 points)
- 5) Consider a frictionless piston that acts on  $n$  moles of gas. The piston expands irreversibly. Write an expression for  $\Delta S$  (inequalities are acceptable if you cannot be more specific, leave in integral form if necessary) if the expansion is (4 points)
  - a) Isothermal
  - b) Adiabatic
  - c) Isobaric and Isothermal
- 6) Write an expression for the change in entropy of water in the reaction  $H_2O_{(g)} \rightarrow H_2O_{(s)}$  at 193K, 1 atm. Express your answer in terms of the constant pressure heat capacities, enthalpy of fusion, and enthalpy of vaporization. What is the sign of  $\Delta S_{\text{sys}}$ ,  $\Delta S_{\text{surr}}$ , and  $\Delta S_{\text{tot}}$ ? (5 points)

**After 1 hour has passed, stop work on this section, and do not return to it. Move on to the open book section immediately.**