Queen Mary University of London

Thermodynamics 1 DEN107

Problem Set 06 (due week 8, Mon 2012Feb27)

Insert the SEMS homework coverpage as 1st page; this question sheet with original signatures as the 2nd page; then attach your solutions in subsequent pages. Your solutions are due before 3.30 pm on Monday February 27th 2012 in the cabinet outside the SEMS office.

Student Surname:	
Student Forenames:	
Student ID (9 digits):	
Student signature:	
TA confirms tutorial attendance (signature):	NOT NEEDED THIS TIME

HINT: Make sure to do problems 4, 5, and 6. Variations of these problems appear frequently in the exams. I have reduced the penalty for late submission of this homework to 10% per day.

Problem 1

Prove that among the many possible states of a system with given (E, n, β) the entropy of the unique stable equilibrium state referred to in the second law of thermodynamics is the state with maximum entropy. Hint: see page 140 of the notes.

Problem 2

Prove that among the many possible states of a system with given (S, n, β) there exists a unique stable equilibrium state and it corresponds to the state of minimum energy. Hint: see page 140 of the notes.

Problem 3

Prove that the constant used in the definition of entropy is equal to the temperature of the reservoir, $C_{\mathrm{R}} = T^{\mathrm{R}}$. Hint - see page 146 of the notes.

Problem 4

Study pages 73-77 from the notes. Consider the use of equations 34 and 36 among two arbitrary states of a system. Then consider under what conditions you may use the equations below equations 36 (these six equations will be used extensively in the rest of the module).

Do problem 5-09 on page 86 from the notes for T_1^{A} =750 K, T_1^{B} =650 K, p_1^{B} =550 kPa.

Problem 5

Study page 92 from the notes.

Do problem 6-08 on page 98 from the notes for T_1^{A} =750 K, T_1^{B} =650 K, p_1^{B} =550 kPa.

HINT: In both problems 4 and 5 for the gas $DE = mC(T_2 - T_1)$. Note use of C_v and where the use of C_p comes from in problem 5.

Problem 6

Do problem 5-12 from the notes for $V = 0.09$ m^3. Also consider how you would solve this problem for $V = 0.086$ m^3. Hint: you would need to do all the interpolations for the new value of specific volume.