CHARLES DARWIN UNIVERSITY

Family Name	
Given Names	
Student Number	
Teaching Period	Semester 1, 2017

FINAL EXAMINATION	**DURATION**
ENG442 – Chemical Engineering Thermodynamics	Reading Time: **10** minutes Writing Time: **120** minutes

INSTRUCTIONS TO CANDIDATES

EXAM CONDITIONS

You may begin writing from the commencement of the examination session. The reading time indicated above is provided as a guide only.

This is a RESTRICTED OPEN BOOK examination

Any non-programmable calculator is permitted

One A4 sheet of handwritten double-sided notes permitted

No dictionaries are permitted

ADDITIONAL AUTHORISED MATERIALS	**EXAMINATION MATERIALS TO BE SUPPLIED**
Lecture Notes (Annotated Permitted)	1 x 20 Page Book Reference Information

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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The exam should be answered on the Answer Sheet provided. Please ensure that your name and student number have been written on the Answer sheet and place in the completed answer Booklet.

Marks for each question are indicated

Question 1 **(20 marks)**

One mole of O_2 expands reversibly from an initial state at T_1 =300 K and P_1 = 5 atm to a final state of T_2 = 250 K and P_2 = 1 atm. The path is first isothermal, to a pressure P, and then isochoric from 300 K to 250 K.

a) Sketch the process on a P-v diagram, and calculate the reversible work of expansion. (6 marks)
b) Calculate the change in internal energy (7 marks)
c) Calculate the heat Q. (7 marks)

The values for the heat capacity at constant pressure and volume are 7R/2 and 5R/2, respectively. Assume the gas as an ideal gas. R = 8.314 J/(mol K)

Question 2 **(30 marks)**

An equimolar mixture of n-butane and n-hexane at a pressure P is brought to a temperature of 95°C, where it exists as a vapour/ liquid mixture in equilibrium. If the mole fraction of n–hexane in the liquid phase is 0.75, then:

a) Develop and explain a detailed algorithm for the solutions for points below. (15 marks)
b) Using the algorithm in part (a)
    i. Calculate the total pressure of the system (in bar) (7.5 marks)
    ii. Calculate the composition of the vapour phase (7.5 marks)

Additional data are in Figure 1.

Question 3 **(30 marks)**

An insulated tank, open to the atmosphere, contains 1500 lbm of 40wt% sulfuric acid at 60 °F. It is heated to 180 °F by injection of live saturated steam at 1 atm (Hv = 1150.5 BTU/lbm) which fully condenses in the process. Additional data are in Figures 2 and 3.

a) Develop and explain detailed algorithms for the solutions of the two following questions (15 marks)
    i. How much steam is required in the process? (7.5 marks)
    ii. What is the final concentration of the acid in the tank? (7.5 marks)

Question 4 **(20 marks)**

Develop and explain a laboratory experiment to determine the heat of disolution of sulfuric acid in water.