

**UNIVERSITY OF TECHNOLOGY, JAMAICA**

**COLLEGE/ FACULTY:** Faculty of Engineering and Computing

**SCHOOL/ DEPARTMENT:** SOE/ChemicalEngineering

**Mid-semester Examination 1, Semester 1**

**Module Name:** Chemical Engineering Thermodynamics 1

**Module Code:** CHE3003

**Date:** October 8, 2013

**Theory/ Practical:** Theory

**Groups:** B.ENG.3C

**Duration:** 1 hour & 45 minutes

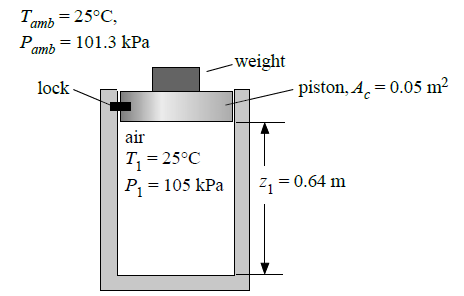
**Instructions**

1. Answer all questions.
2. EACH QUESTION MUST BEGIN ON A NEW PAGE.
3. LEAVE TWO LINES BETWEEN PARTS OF A QUESTION.
4. SHOW CLEARLY ALL EQUATIONS USED FOR CALCULATIONS.
5. ANSWERS MUST BE NUMBERED IDENTICAL TO THE QUESTION BEING ANSWERED.
6. READ THE QUESTION COMPLETELY BEFORE ANSWERING.
7. THE INTENDED MARK IS INDICATED AT THE BEGINING OF THE QUESTION.
8. **FORMULA SHEET, UNIT CONVERSION CHART AND PROPERTY TABLES ARE ATTACHED.**

**\*\*\* DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO \*\*\***

**Question #1 [20 marks]**

The piston-cylinder apparatus shown in Figure 1 contains air at *T*1 = 25°C and *P*1 = 105 kPa. The piston is initially *z*1 = 0.64 m above the cylinder bottom and is held in place by a lock. The cross-sectional area of the piston is *Ac* = 0.05 m2. A weight is now placed on the piston. The lock is released and the piston falls. After a period of time, heat transfer between the air in the cylinder and the surroundings (which are at *Tamb* = 25°C and *Patm* = 101.3 kPa) restores the air temperature to *T*2 = 25°C. At this point, the piston is *z*2 = 0.58 m above the cylinder bottom.



*Figure 1: Piston cylinder apparatus*

* + 1. Determine the combined mass of the piston and weight. **[10]**
    2. Determine the work done (including direction) during this process. **[5]**
    3. Determine the heat transfer (including direction) this process. **[5]**

*N.B. Clearly state what is being taken as the system.*

**Question #2 [20 marks]**

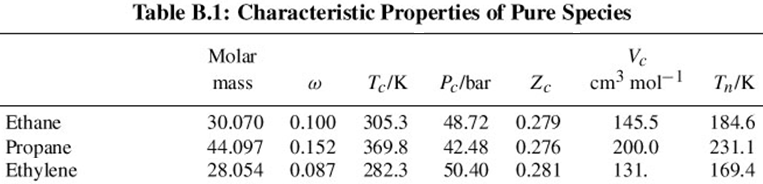
One kmol of an ideal gas, initially at 303.15 K and 1 bar, undergoes the following mechanically reversible changes. It is compressed isothermally to a point such that when it is heated at constant volume to 393.15 K its final pressure is 12 bar. Sketch the process on a P-V graph and calculate Q, W, ΔU, and ΔH for the process. Take Cp = (7/2)R and Cv = (5/2)R.

**Question #3 [30 marks]**

Using the Soave/Redlich/Kwong equation, estimate the mass of ethylene (in kg) contained in a 0.25 m3 cylinder at 323.15 K and 115 bar. *Justify your choice of equation.*

**Total Marks = 70**

**\*\*\*\*\* END OF PAPER \*\*\*\*\***

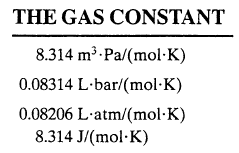
Formula Sheet

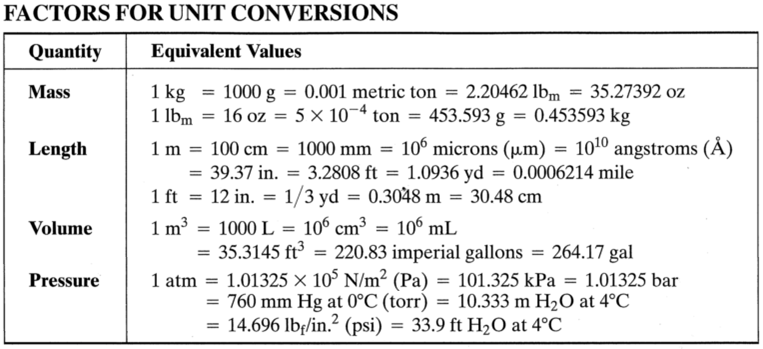
*For Vapour and Vapour-like Roots*

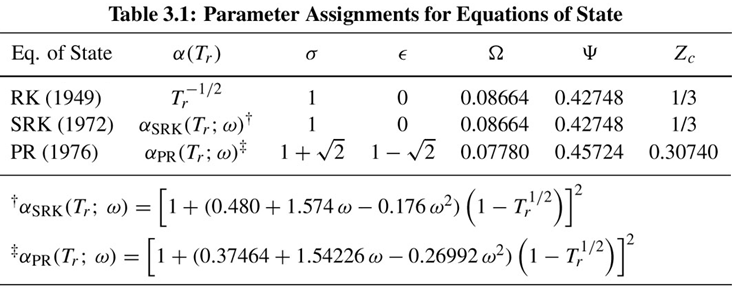
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*For Liquid and Liquid-like Roots*

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