Faculté de génie
Génie mécanique

uOttawa
L'Université canadienne
Canada's university

Faculty of Engineering
Mechanical Engineering

Name_____ ID Number_____

MCG2130 - THERMODYNAMICS I

Midterm Examination
24 October 2014
Prof. W. Hallett

Time: 75 minutes

Version c

Closed book. Put your name on this question paper and hand it in with your exam booklet. **If you do not hand in the question paper your exam will not be marked.** In each problem, state any assumptions you need to make. Properties data are given on the reverse side of the paper.

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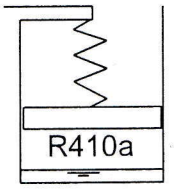
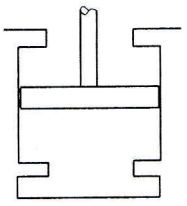
1. (16 marks total) Refrigerant R410a is contained in a cylinder with a leakproof frictionless piston. A linear spring acts on the piston, such that when the pressure is 100 kPa the volume is 0.01 m^3, and when the pressure is 1.0 MPa the volume is 0.035 m^3. The cylinder initially contains 0.02 m^3 of saturated R410a at -30 °C, of which 1% by volume is saturated liquid. The R410a is then heated to a final pressure of 600 kPa.



(a) (2 marks) Draw this process on a P-v diagram, showing lines of constant temperature at the initial and final state. Also show on this diagram the critical point, the superheated vapour region, and the compressed liquid region.
(b) (3 marks) Calculate the final volume in the cylinder.
(c) (3 marks) Calculate the work done in kJ.
(d) (8 marks) Calculate the heat transfer in kJ and the final temperature.

2. (8 marks total) Air is contained in a cylinder with a leakproof frictionless piston at an initial state of $T_1 = 20\,°C$, $P_1 = 150$ kPa, and $V_1 = 0.015\ m^3$. The air is heated until a final temperature of 300 °C is reached. The piston maintains a constant pressure until it reaches the end of the cylinder, at which point the volume reaches a maximum value of 0.02 m^3.



(a) (1 mark) Sketch this process on a T-v diagram, showing lines of constant pressure at the initial and final pressure.
(b) (3 marks) Determine whether the piston reaches the end of the cylinder or not and determine the final pressure.
(c) (4 marks) Calculate the work done and the heat transfer.

Total marks for this paper: 24

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