Minor 1 (MCL142), Semester 2, 2017-2018	
Time: 1 hour	Full marks: 25
Venue: LH 114	Date: 07/02/2018

Instructions: *Attempt all questions. Clearly specify part numbers such as 1(a), 2(c) etc. corresponding to your answers. One mark will be deducted for unnumbered attempts. All parts of the same question must be placed together in your answer-script, e.g. your answer to 1(b) cannot be placed immediately after your answer to 2(a). Else, a penalty of two marks apply. A penalty of one mark applies for submitting an untidy answer-script.*

Question 1.

Part A. Define a *quasi-equilibrium process* and give an example.

Part B. Air enters an adiabatic nozzle steadily at 300 kPa, 200°C, and 45 m/s and leaves at 100 kPa and 180 m/s. The inlet area of the nozzle is 110 cm^2. Determine the **mass flow rate**, the **exit area** and the **exit temperature**. You can take C_p of air to have an approximately constant value of 1.02 kJ/kg/K for this temperature range. Show all steps and state the principal assumptions.

(3+9)

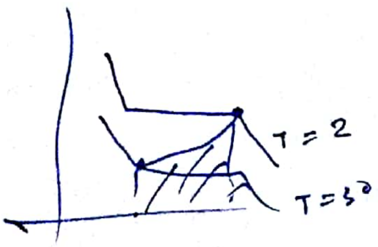
Question 2.

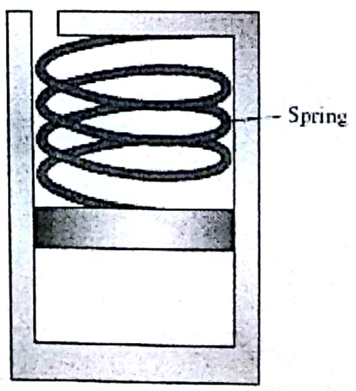
Part A. Concisely and in neat handwriting discuss the difference between *thermal equilibrium* and *thermodynamic equilibrium.*

Part B. Draw a neat and clearly labeled schematic T-v diagram for a pure substance showing the two-phase (liquid-vapor) region and two representative isobars, one of which passes through the critical point.

Part C. Saturated water vapor at 200°C is slowly condensed to a saturated liquid at 50°C with the help of a **spring-loaded** piston-cylinder device like the one shown in figure. Determine the heat transfer for this process, in *kJ/kg*. Draw the process on the P-v diagram, show all your steps and state the principal assumptions. Consult your book of tables, where necessary.

(2+3+8)





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