Thermodynamics Exam #1 (total 100%)

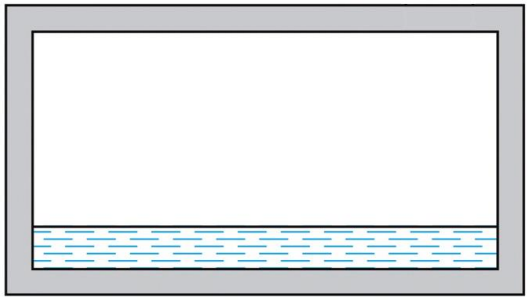
Dept. of Engineering Science, 2016 Fall 2016/11/09

1. (20%) Sketch and show the following states on a P-*v* diagram and a T-*v* diagram, respectively. Note that two constant-pressure lines and two constant-temperature lines are to be drawn, respectively. (indicate which lines are larger)
   - ∗ liquid-vapor mixture region.
   - ∗ compressed liquid region.
   - ∗ saturated liquid.
   - ∗ saturated vapor.
   - ∗ superheated vapor region.
   - ∗ critical point.

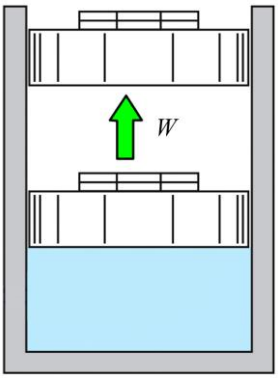
2. (20%) Clearly explain the following:
   1) State the first law of thermodynamics for a control mass undergoing a cycle.
   2) Deduce the first law of thermodynamics for a change in state of a control mass. (concepts of properties E and U need to be deduced)

3. (12%) Describe the three different methods for calculating enthalpy changes for air. Also, describe methods for calculating enthalpy changes for H_2O (at least one method).

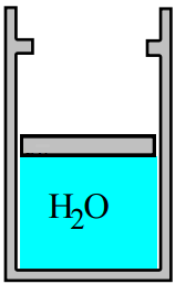
4. (8%) (from2.53) A 400-m³ storage tank is being constructed to hold LNG, liquefied natural gas, which may be assumed to be essentially pure methane (CH_4). If the tank is to contain 98% liquid and 2% vapor, by volume, at 100 kPa, what mass of LNG (kg) will the tank hold? What is the quality in the tank?



5. (10%) (from 3.76) A piston cylinder contains air at 600 kPa, 290 K and a volume of 0.01 m³. A constant pressure process gives 54 kJ of work out. Find the final volume, the temperature of the air and the heat transfer.



6. (15%) (from 3.134) A piston/cylinder contains 1 kg of liquid water at 20℃ and 300 kPa. Initially the piston floats, as shown in Fig. P3.134, with a maximum enclosed volume of 0.002 m³ if the piston touches the stops. Now heat is added so a final pressure of 600 kPa is reached. Find the final volume and the heat transfer in the process.



7. (15%) (from 3.136) A piston cylinder contains air at 1000 kPa, 800 K with a volume of 0.05 m³. The piston is pressed against the upper stops, see Fig. P3.14c and it will float at a pressure of 750 kPa. Now the air is cooled to 400 K. What is the process work and heat transfer?