

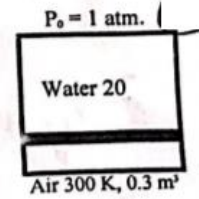
ME 40 Thermodynamics
Fall 2019 Midterm 1

Name: _____

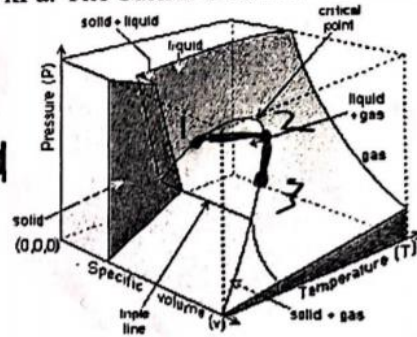
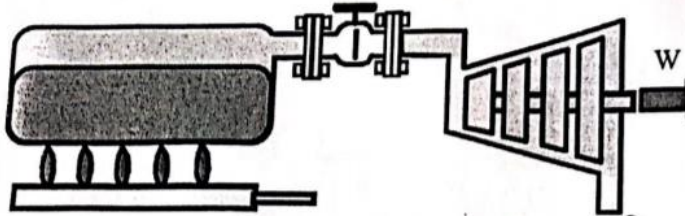
1. (50 pts.) A 10-meter high, insulated cylinder, cross-sectional area 0.1 m^2 , has a massless piston near the bottom which contains air at 300 K , in a volume of 0.3 m^3 . The air is heated so that the piston moves up, spilling water over the side until the piston reaches the top of the cylinder.

- Write the energy equation for the process. (you may assume constant specific heat).
- Calculate the initial masses of water and air, and pressure of air.
- Find the final pressure and temperature of air when all the water has been pushed out.
- Find the total heat transfer to the air when all the water has been pushed out.
- Show the process on a PV diagram.

Hint: Try simplifying the work calculation by using your PV diagram and a geometric analysis.



2. (50 pts.) The steam engine shown has a boiler tank with a volume of 100 L and initially contains saturated liquid with a very small amount of air at 100 kPa. Heat is now added by the burner, and the pressure regulator does not open before the boiler pressure reaches 700 kPa, which it keeps constant. The saturated vapor enters the turbine at 700 kPa and is discharged to the atmosphere as saturated vapor at 100 kPa. The burner is turned off when no more liquid is present in the boiler.



- Find the total turbine work and the total heat transfer to the boiler for this process.
- Diagram the process on the figure above.