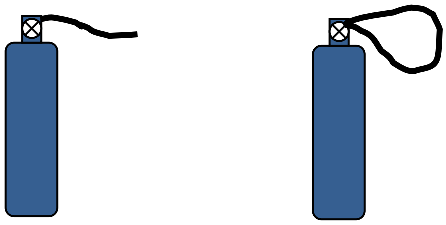
TUTORIAL-2 (05 Feb 2019)
Thermodynamics for Aerospace Engineers (AS1300)

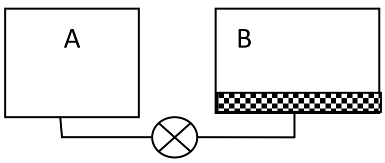
1. Gas from bottle of compressed helium is used to inflate an inelastic flexible balloon, originally folded completely (zero volume), to a volume of 0.5 m3. If the barometer reads 760 mmHg, what is the amount if work done upon the atmosphere by the balloon? Sketch the system before and after the process.



2. When the valve of the evacuated bottle (similar to the figure above) is opened, atmosphere air rushes into it. If the atmospheric pressure is 101325 Pa, and 0.6 m3 of air (measured at atmospheric conditions) enters into the bottle, calculate the work done by the air.

3. A pump forces water at 1m3/min horizontally from an open well to a closed tank where the pressure is 0.9 MPa. Compute the work the pump must do upon the water in an hour just to force the water into the tank against the pressure. Sketch the system on which work is done, before and after the process.

4. Tank A shown in figure below has a volume of 0.4 m^3 and contains Argon gas at 250 kPa. Cylinder B contains a frictionless piston of mass such that a pressure of 150 kPa is required to lift it. The connecting valve is opened allowing the gas to flow into the cylinder. Eventually, the argon reaches a uniform state. Determine a) the final pressure, b) the work interaction for the argon gas, piston and the atmosphere. Assume that any change in the state of the gas is governed by PV-constant.



5. It is desired to melt aluminum (melting point 660°C) with solid state specific heat capacity 0.9 kJ/kg K and latent heat 390 kJ/kg. The initial temperature of solid aluminum is 15°C and the final temperature of molten aluminum is 700°C. The specific heat capacity of molten metal is 1.11 kJ/kg K and density is 2400 kg/m3.Find how much metal can be melted to the required state per hour in a 2.17 MW furnace.

6. 1 kg of air initially at 5 bar, 350 K, and 3kg of CO2 initially at 2 bar, 450 K are confined to opposite sides of a rigid, well insulated container as shown in the figure. The partition which is held in place by a pin, is thermally conducting and free to move. The pin is now removed and the gases are allowed to come to equillibrium. Find the final temperature and pressure of the gases. Assume air to be an ideal gas with Pv=288.68*T and C_v=733 kJ/kg. Assume CO2 to be following Pv=189*T, and C_v=750 kJ/kg. P is in Pa, and v is n m^3/kg. Hint: Look at the two systems together.