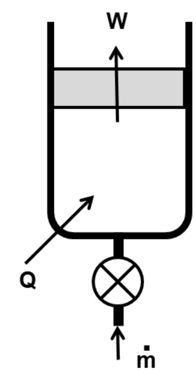
HW – 19: Transient Open Systems

i) An **evacuated tank** having an internal volume of 0.75 m^3 is sitting in a room where the air is at 1 bar and 25°C. The tank develops a small leak and eventually, the air pressure within the tank reaches 1 bar. The process is slow enough such that the temperature remains constant at 25°C. Determine the heat transfer for the process in kJ.

ii) A 5-gallon tank used by a refrigerator repair person that initially contains a two-phase mixture of R134a at 20°C develops a small leak at the top. The process is slow enough such that the temperature remains constant at 20°C. If the initial contents are 90% liquid by mass, then determine the heat transfer (kJ) that occurred over the time it took for all the liquid to disappear in the tank (i.e. final state of saturated vapor at 20°C).

HW – 20: Transient Open System with Boundary Work

A piston-cylinder device initially contains 0.6 kg of water substance occupying a volume of 0.1 m^3 at an absolute pressure of 10 bar (State 1). The cylinder is connected through a valve to a large supply line containing steam at an absolute pressure of 40 bar and a temperature of 500°C. The valve is opened so that steam flows into the cylinder until the volume increases to 0.2 m^3 and the temperature is 240°C (State 2) while the absolute pressure in the cylinder remains constant at 10 bar throughout the process.

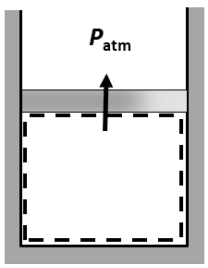


(a) Calculate the final mass in the cylinder and the mass of steam entering the cylinder from the supply line, in kg.
(b) Find the work during the process, in kJ.
(c) Determine the heat transfer during the process, in kJ.

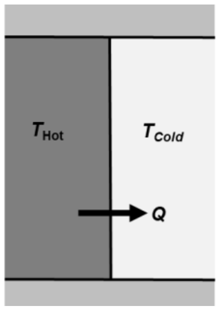
HW – 21: Reversible Processes

i) Is each swing of the pendulum clock outside of ME 1130 an example of a thermodynamically reversible process? Explain why or why not.

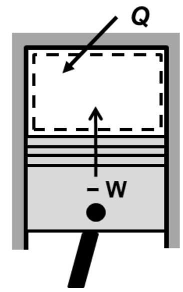
ii) A gas is expanding against the atmosphere with a massless piston. What is necessary for this to be a reversible process?



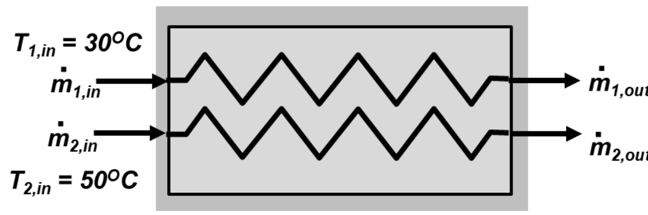
iii) What is necessary for this heat transfer process to be reversible?



iv) A closed system process involves compression and heat transfer to the fluid. What idealized conditions are necessary for the process to be internally reversible when considering the fluid as the system? Do the temperature and pressure need to be constant in order for this to internally reversible? Does the piston need to be frictionless? Explain.



v) Is it theoretically (thermodynamically) possible for a parallel flow heat exchanger with the inlet conditions shown to approach a thermodynamically reversible process? Explain why or why not? If yes, then show a system configuration that could be utilized to thermodynamically reverse the process.



vi) Is it theoretically (thermodynamically) possible for a counterflow heat exchanger with the inlet conditions shown below to approach a thermodynamically reversible process? Explain why or why not? If yes, then show a system configuration that could be utilized to thermodynamically reverse the process.