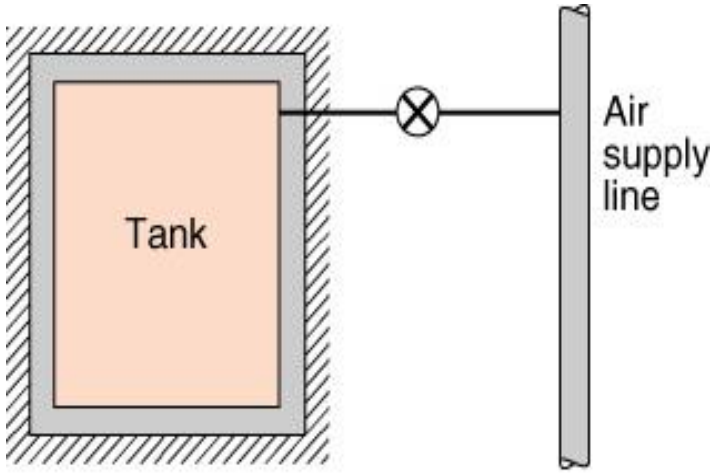
Questions on chapter 6

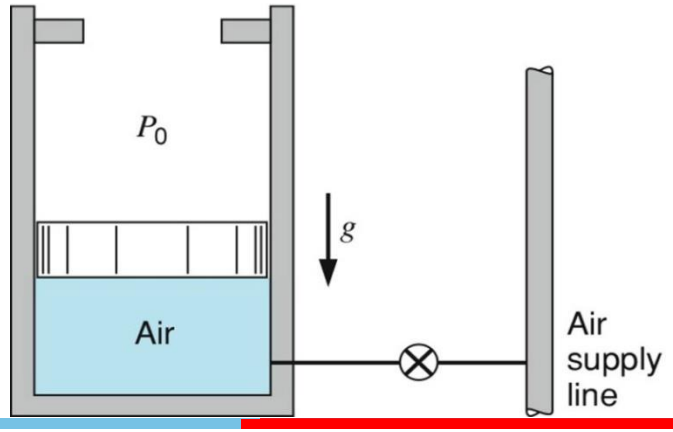
A 25-L tank, shown in Fig. that is initially evacuated is connected by a valve to an air supply line flowing air at 25°C, 800 kPa. The valve is opened, and air flows into the tank until the pressure reaches 600 kPa. Determine the final temperature and mass inside the tank, assuming the process is adiabatic.



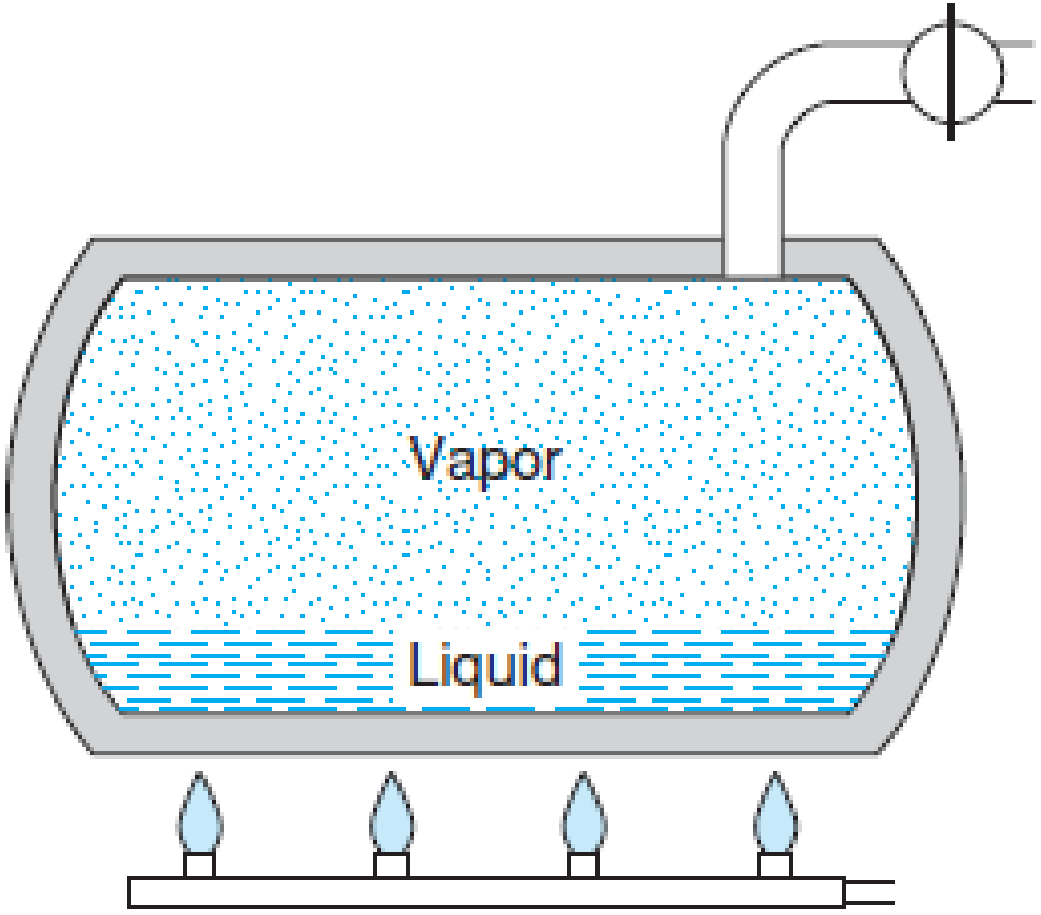
Ans: Tfinal=416.72K
and m= 0.12542kg

A mass-loaded piston/cylinder, shown in Fig., containing air is at 300 kPa, 17°C with a volume of 0.25 m^3, while at the stops V = 1 m^3. An air line, 500 kPa, 600 K, is connected by a valve that is then opened until a final inside pressure of 400 kPa is reached, at which point T = 350 K. Find the air mass that enters, the work, and heat transfer.

mi= 3.082kg; W=225kJ; Q=-819.2 kJ

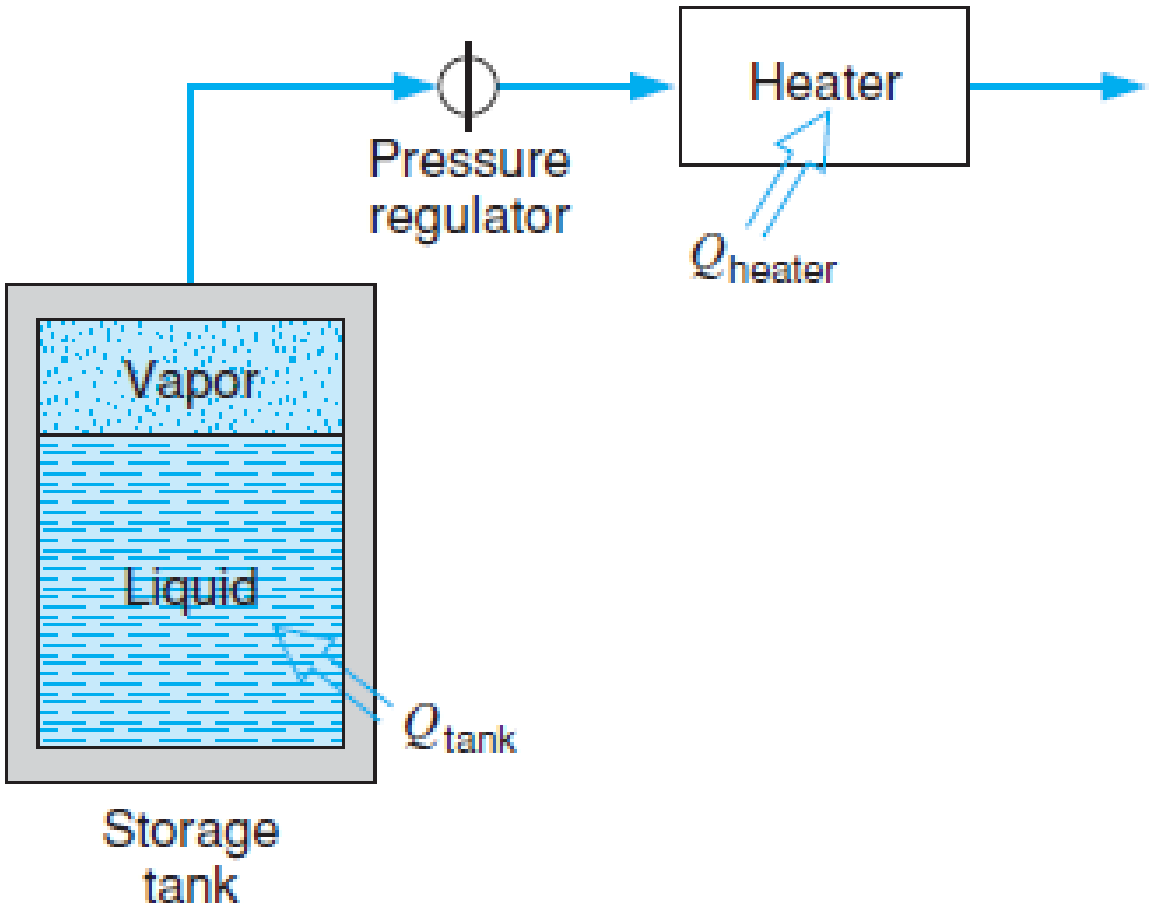


A 200-L tank (see Fig.) initially contains water at 100 kPa and a quality of 1%. Heat is transferred to the water, thereby raising its pressure and temperature. At a pressure of 2 MPa, a safety valve opens and saturated vapor at 2 MPa flows out. The process continues, maintaining 2 MPa inside until the quality in the tank is 90%, then stops. Determine the total mass of water that flowed out and the total heat transfer.

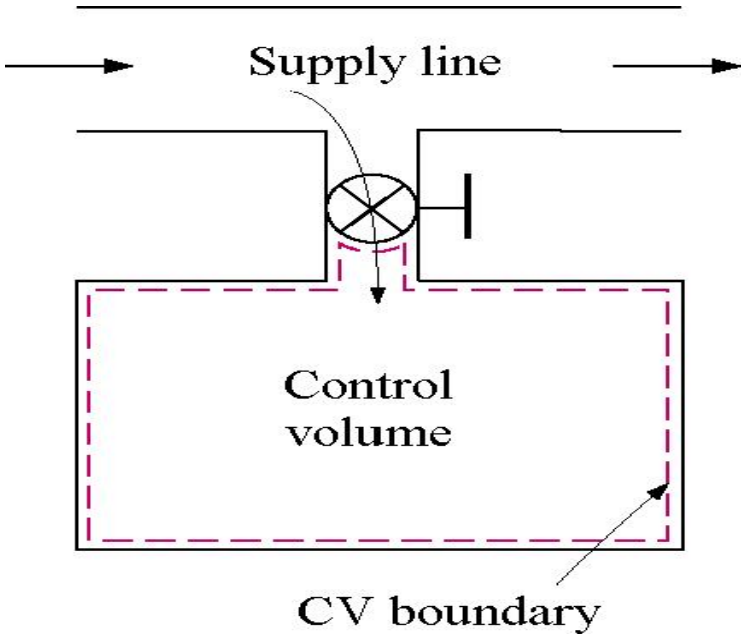


Answers:
me=8.90
Q=254569kJ

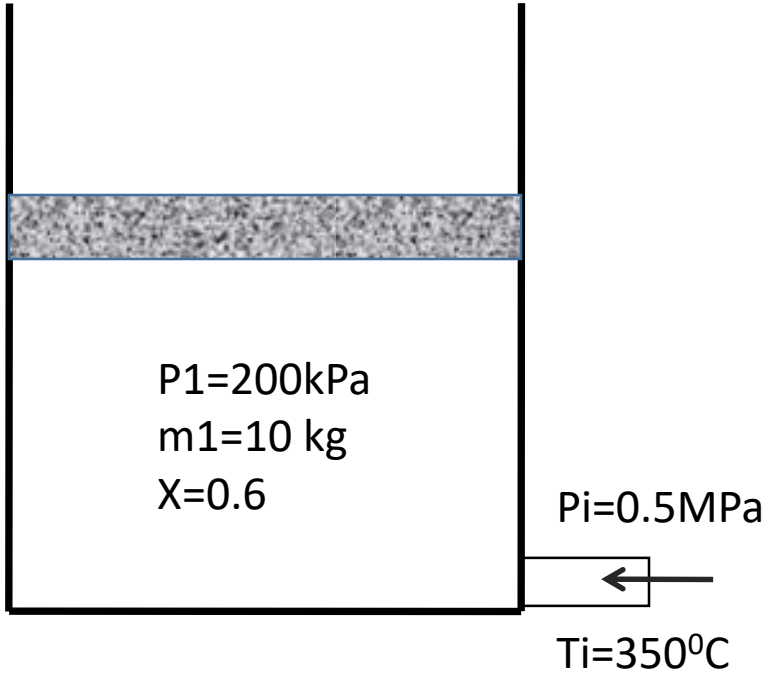
A 2-m^3 storage tank contains 95% liquid and 5% vapor by volume of liquified natural gas (LNG) at 160 K, as shown in Fig. It may be assumed that LNG has the same properties as pure methane. Heat is transferred to the tank and saturated vapor at 160 K flows into the steady flow heater, which it leaves at 300 K. The process continues until all the liquid in the storage tank is gone. Calculate the total amount of heat transfer to the tank and the total amount of heat transferred to the heater.


Heater
Pressure regulator
Q_{heater}
Vapor
Liquid
Q_{tank}
Storage tank

- An evacuated 150-L tank is connected to a line flowing air at room temperature, 25°C, and 8 MPa pressure. The valve is opened allowing air to flow into the tank until the pressure inside is 6 MPa. At this point the valve is closed. This filling process occurs rapidly and is essentially adiabatic. The tank is then placed in storage where it eventually returns to room temperature. What is the final pressure?

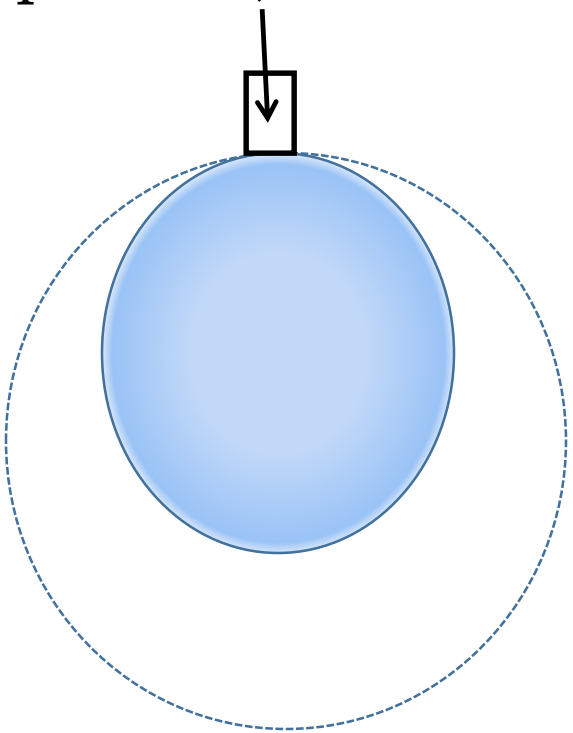


- A insulated cylinder initially contains saturated liquid-vapor mixture of water. The cylinder is connected to a supply line, and the steam is allowed to enter the cylinder until all the liquid is vaporized. The final temperature in the cylinder and the mass of the steam that entered are to be determined.



T=120.23^{0}C and m=19.104 kg

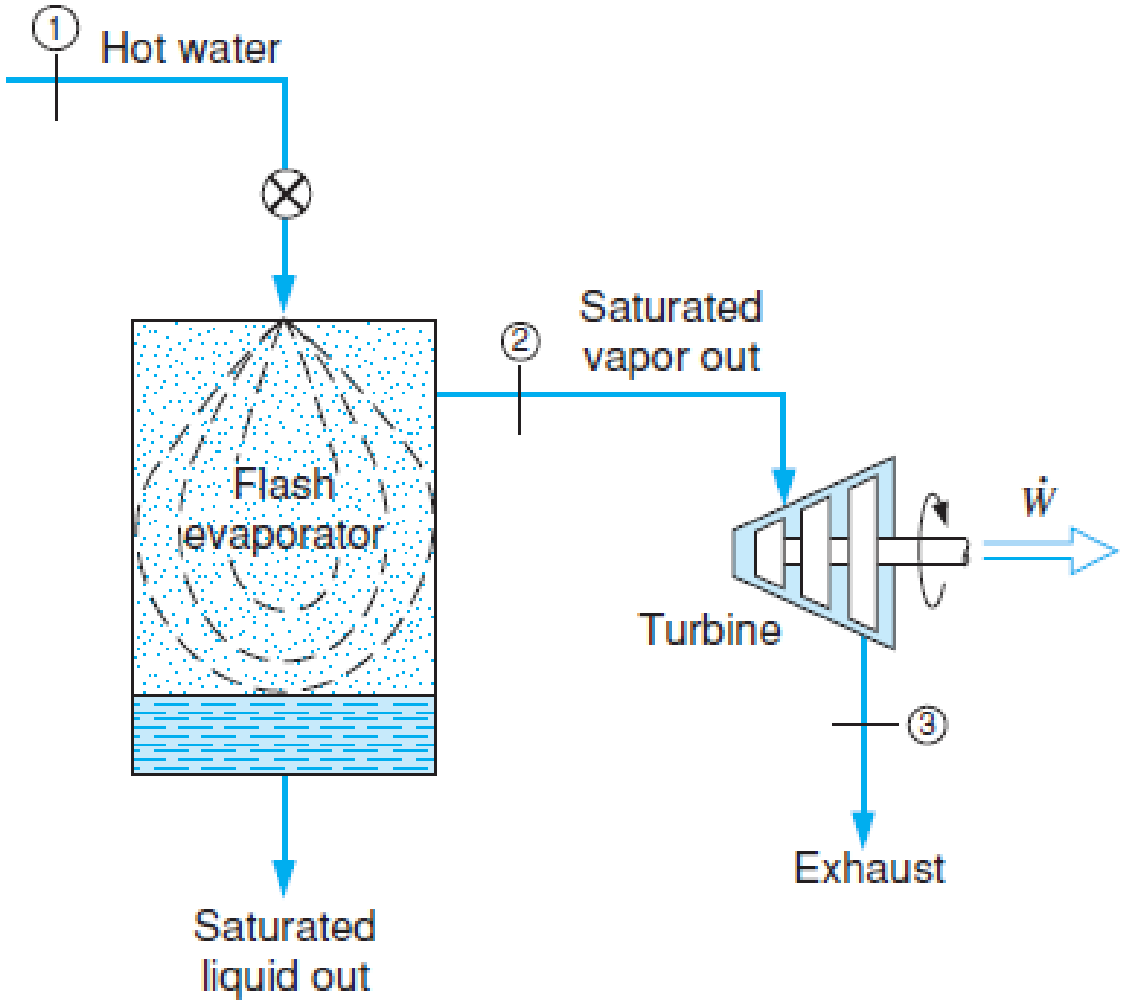
A balloon is initially contains $65m^3$ of helium gas at atmospheric conditions of 100kPa and 22^0C. The balloon is connected by a valve to a large reservoir that supplies helium gas at 150kPa and 25^0C. Now the valve is opened and the helium is allowed to enter the balloon until the pressure equilibrium with the helium at the supply line is reached. The material of the balloon is such that the volume increases linearly with pressure. If no heat transfer takes place during the process, determine the final temperature in the balloon.



T=334K

- A tank of 2 m^3 volume contains saturated ammonia at a temperature of 40°C. Initially the tank contains 50% liquid and 50% vapor by volume. Vapor is withdrawn from the top of the tank until the temperature is 10°C. Assuming that only vapor (i.e., no liquid) leaves and that the process is adiabatic, calculate the mass of ammonia that is withdrawn.

A proposal is made to use a geothermal supply of hot water to operate a steam turbine, as shown in Fig. P4.125. The high-pressure water at 1.5MPa, 180◦C is throttled into a flash evaporator chamber, which forms liquid and vapor at a lower pressure of 400 kPa. The liquid is discarded, while the saturated vapor feeds the turbine and exits at 10 kPa with a 90% quality. If the turbine should produce 1 MW, find the required mass flow rate of hot geothermal water in kilograms per hour.


1
Hot water
2
Saturated
vapor out
Flash
evaporator
Turbine
$\dot{W}$
3
Exhaust
Saturated
liquid out