UCH305 (Chemical Engineering Thermodynamics I)

Tutorial Sheet No.4 (Application of First Law for Closed Systems)

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Q.1 A constant pressure piston cylinder contains 0.2 kg water as saturated vapor at 400 kPa. It is now cooled so the water occupies half the original volume. Find the work of the process.

Q.2 A piston cylinder contains 0.5 kg air at 500 kPa, 500 K. The air expands in a process so P is linearly decreasing with volume to a final state of 100 kPa, 300 K. Find the work in the process.

Q.3 A gas initially at 1 MPa , 500^{o} C is contained in a piston and cylinder arrangement with an initial volume of 0.1 m^3. The gas is then slowly expanded according to the relation PV =constant until a final pressure of 100 kPa is reached .Determine the work for this process.

Q.4 Air goes through a polytropic process from 125 kPa, 325 K to 300 kPa and 500 K. Find the polytropic exponent n and the specific work in the process.

Q.5 10 kg of water in a piston cylinder arrangement exists as saturated liquid /vapor at 100 kPa, with a quality of 50%. It is now heated so the volume triples. The mass of the piston is such that a cylinder pressure of 200 kPa will float it. Find out final temperature, volume of the water and work given out by the water.

Q.6 Air at 200 kPa, 30^0 C is contained in cylinder / piston arrangement with initial volume 0.1 m^3. The inside pressure balances ambient pressure of 100 kPa plus an externally imposed force that is proportional to $V^{0.5}$. Now heat is transferred to the system to a final pressure of 225 kPa. Find the final temperature and the work done in the process.

Q.7 A water-filled reactor with volume of 1m^3 is at 20 MPa, 360^0C and placed inside a containment room. The room is well insulated and initially evacuated. Due to failure, the reactor ruptures and the water fill the containment room. Find the minimum room volume so that final pressure does not exceed 200 kPa.

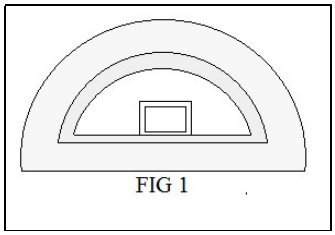

FIG 1

Q.8 A piston /cylinder assembly contains 1 kg of liquid water at 20^0 C and 300 kPa. There is a linear spring mounted on the piston such that when the water is heated the pressure reaches 1 MPa with a volume of 0.1 m^3. Find the final temperature and the heat transfer in the process.