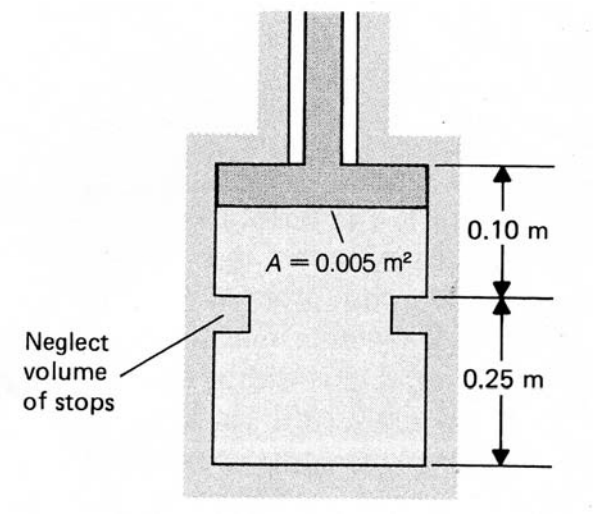
Unified Engineering Spring 2007
Thermodynamics & Propulsion Z. S. Spakovszky

(Add a short summary of the concepts you are using to solve the problem)

Problem T1

A 25 kg piston is required to travel a specific distance within the piston-cylinder arrangement shown below. The piston initially rests on the bottom stops. There is an ideal gas with a gas constant of R = 287 J/kg-K inside the cylinder. The ideal gas is heated, and the piston moves until it touches the upper stops, as shown in the figure. Initially, the ideal gas inside the cylinder is at ambient conditions, that is $p_0 = p_{amb}$ = 1 bar and $T_0 = T_{amb}$ = 300K. The stops and the piston are very thin compared to the dimensions of the cylinder such that both the piston volume and the volume of the stops can be neglected.



a) Draw the p-V diagram for this process.

b) Calculate the work done by the gas.

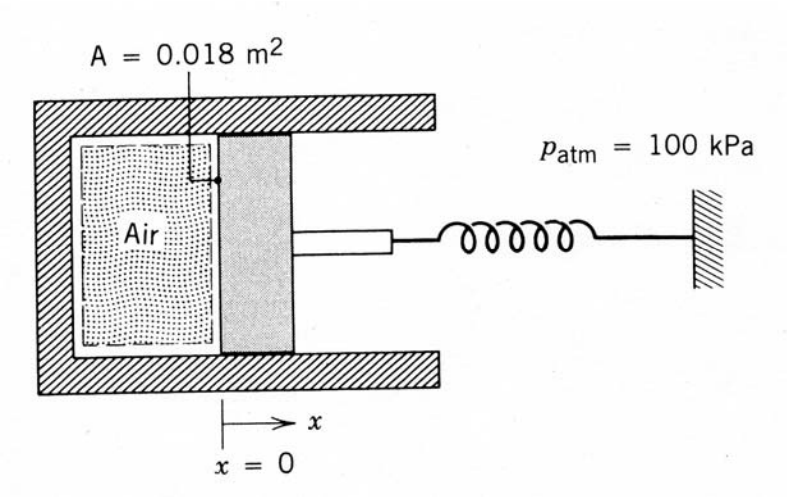
c) Determine the final temperature of the gas.

Unified Engineering Spring 2007
Thermodynamics & Propulsion Z. S. Spakovszky

(Add a short summary of the concepts you are using to solve the problem)

Problem T2

Air is trapped in a piston-cylinder assembly oriented horizontally as shown below. Initially, the pressure of air is 1 bar and the volume is 0.002 m^3, and the face of the piston is at distance x = 0 m. The spring exerts no forced on the piston in the initial position. The atmospheric pressure is 1 bar, and the area of the piston face is 0.018 m^2. The piston moves slowly until its volume is 0.003 m^3. During this process, the spring exerts a force on the piston that varies linearly in x such that $F = kx$, where k = 16,200 N/m. There is no friction between the piston and the cylinder wall.



a) Determine the final pressure of the air.

b) Find the work done by the air on the piston.

c) Is this process reversible? Why or why not? A discussion is expected with a phenomenological description of the involved processes.

d) If the opposite of your answer in c) was true, what would have to happen assuming that the piston is still frictionless? Again, describe the involved processes.

Unified Engineering Spring 2007
Thermodynamics & Propulsion Z. S. Spakovszky

(Add a short summary of the concepts you are using to solve the problem)

Problem T3

During a reversible process executed by a non-flow system, the pressure increases from 345 kPa to 1,380 kPa in accordance with $pV = C$, and the internal energy increases by 22,575 J. The initial volume is $V_1 = 85$ l.

a) Find the work. Is work done *by* the system or is work done *on* the system? Explain.

b) Find the heat transferred.

c) Is heat absorbed or rejected by the system? Substantiate your answer by sketching a generic system and indicating the heat and work flows.