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TM 344 – Termodinâmica I (Noturno)
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2.33 – O gás Monóxido de Carbono (CO) contido em um cilindro-pistão passa por três processos em série:

Processo 1–2: Expansão de p_1 = 5 bar, V_1 = 0.2 m^3 para V_2 = 1 m^3, durante a qual a relação pressão-volume é pV = constante.

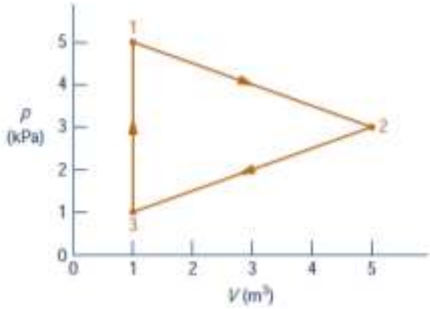
Processo 2–3: Aquecimento a volume constante onde p_3 = 5 bar.

Processo 3–1: Compressão a pressão constante até o estado inicial.

Esboce o diagrama p-V e determine o trabalho para cada processo em kJ.

2.68 – Ar é mantido em um conjunto cilindro-pistão vertical por um pistão com 25 kg de massa e uma área de face de 0,005 m^2. A massa de ar tem 2,5 g e incialmente ocupa um volume de 2,5l. A atmosfera exerce uma pressão de 100 kPa sobre o topo do pistão. O volume do ar diminui lentamente para 0,001 m^3 conforme a energia é removida por transferência de calor com magnitude de 1kJ. Desprezando o atrito entre o pistão e a parede do cilindro, determine a variação de energia interna e específica do ar, em kJ/kg. Considere g=9,81 m/s^2.

2.73 - Figure P2.73 shows a power cycle executed by a gas in a piston-cylinder assembly. For process 1–2, $U2 - U1$ = 15 kJ. For process 3-1, $Q31$ = 10 kJ. There are no changes in kinetic or potential energy. Determine (a) the work for each process, in kJ, (b) the heat transfer for processes 1–2 and 2–3, each in kJ, and (c) the thermal efficiency.

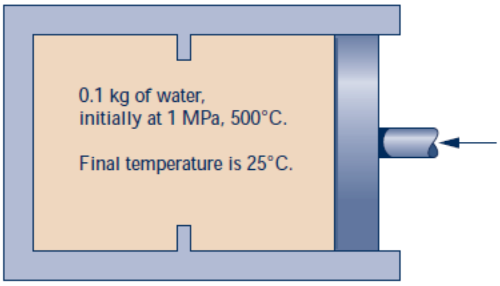


3.42 - Using the tables for water, determine the specified property data at the indicated states. In each case, locate the state by hand on sketches of the *p*–v and *T*–v diagrams.

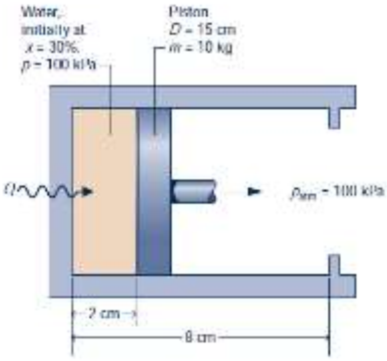
(a) At *p* = 2 MPa, *T* = 300°C. Find *u*, in kJ/kg.
(b) At *p* = 2.5 MPa, *T* = 200°C. Find *u*, in kJ/kg.
(c) At *T* = 170 F, *x* = 50%. Find *u*, in Btu/lb.
(d) At *p* = 100 lbf/in.2, *T* = 300°F. Find *h*, in Btu/lb
(e) At *p* = 1.5 MPa, y = 0.2095 m3/kg. Find *h*, in kJ/kg.

3.58 A closed, rigid tank contains 2 kg of water, initially a two phase liquid–vapor mixture at 80°C. Heat transfer occurs until the tank contains only saturated vapor with v = 2.045 m^3/kg. For the water, locate the initial and final states on a sketch of the *T*–v diagram and determine the heat transfer, in kJ.

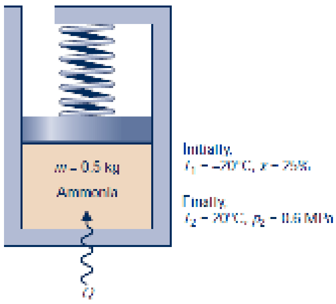
3.75 As shown in Fig. P3.75, a piston-cylinder assembly fitted with stops contains 0.1 kg of water, initially at 1 MPa, 500°C. The water undergoes two processes in series:
Process 1–2: Constant-pressure cooling until the piston face rests against the stops. The volume occupied by the water is then one-half its initial volume.
Process 2–3: With the piston face resting against the stops, the water cools to 25°C.



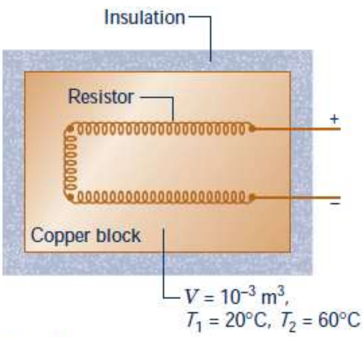
3.76 A two-phase, liquid–vapor mixture of H_2O, initially at x = 30% and a pressure of 100 kPa, is contained in a piston– cylinder assembly, as shown in Fig P3.76. The mass of the piston is 10 kg, and its diameter is 15 cm. The pressure of the surroundings is 100 kPa. As the water is heated, the pressure inside the cylinder remains constant until the piston hits the stops. Heat transfer to the water continues at constant volume until the pressure is 150 kPa. Friction between the piston and the cylinder wall and kinetic and potential energy effects are negligible. For the overall process of the water, determine the work and heat transfer, each in kJ.



3.84 As shown in Fig. P3.84, 0.5 kg of ammonia is contained in a piston–cylinder assembly, initially at T_1 = 220°C and a quality of 25%. As the ammonia is slowly heated to a final state, where T_2 = 20°C, p_2 = 0.6 MPa, its pressure varies linearly with specific volume. There are no significant kinetic and potential energy effects. For the ammonia, (a) show the process on a sketch of the p–y diagram and (b) evaluate the work and heat transfer, each in kJ.

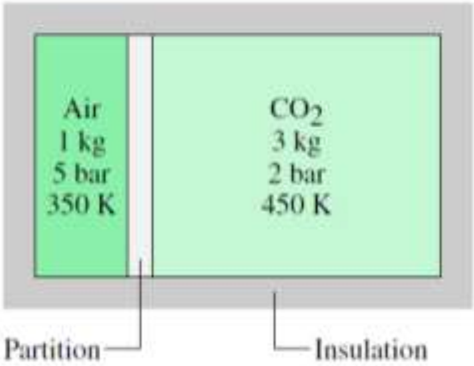


3.86 Shown in Fig. P3.86 is an insulated copper block that receives energy at a rate of 100 W from an embedded resistor. If the block has a volume of 10^{-3} m^3 and an initial temperature of 20°C, how long would it take, in minutes, for the temperature to reach 60°C? Data for copper are provided in Table A-19.



3.97 Five kg of butane (C_4H_{10}) in a piston–cylinder assembly undergo a process from p_1 = 5 MPa, T_1 = 500 K to p_2 = 3 MPa, T_2 = 450 K during which the relationship between pressure and specific volume is pv^n = *constant*. Determine the work, in kJ.

3.62 (5ªEd) One kilogram of air, initially at 5 bar, 350 K, and 3 kg of carbon dioxide (CO_2), initially at 2 bar, 450 K, are confined to opposite sides of a rigid, well-insulated container, as illustrated in Fig. P3.62. The partition is free to move and allows conduction from one gas to the other without energy storage in the partition itself. The air and carbon dioxide each behave as ideal gases. Determine the final equilibrium temperature, in K, and the final pressure, in bar, assuming constant specific heats.



◀ **Figure P3.62**

3.72 Steam, initially at 5 MPa, 280_C undergoes a polytropic process in a piston–cylinder assembly to a final pressure of 20 MPa. Plot the heat transfer, in kJ per kg of steam, for polytropic exponents ranging from 1.0 to 1.6. Also investigate the error in the heat transfer introduced by assuming ideal gas behavior for the steam. Discuss.

3.48 Determine the compressibility factor for water vapor at 200 bar and 470_C, using
(a) data from the compressibility chart.
(b) data from the steam tables.