Fields 19.1

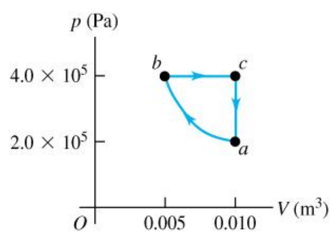
A cylinder with a frictionless, movable piston like that shown in the Figure 19.5 in the textbook, contains a quantity of helium gas. Initially the gas is at a pressure of 1.00×10^5 Pa, has a temperature of 300 K, and occupies a volume of 1.50 L. The gas then undergoes two processes. In the first, the gas is heated and the piston is allowed to move to keep the temperature equal to 300 K. This continues until the pressure reaches 2.50×10^4. In the second process, the gas is compressed at constant pressure until it returns to its original volume of 1.50 L. Assume that the gas may be treated as ideal. Find the volume of the gas at the end of the first process. Find the pressure of the gas at the end of the second process. Find the temperature of the gas at the end of the second process. Find the total work done by the gas in the first process. Find the total work done by the gas in the second process.

Fields 19.2

A cylinder with a piston contains 0.152 mol of nitrogen at a pressure of 1.76×10^5 Pa and a temperature of 340 K. The nitrogen may be treated as an ideal gas. The gas is first compressed isobarically to half its original volume. It then expands adiabatically back to its original volume, and finally it is heated isochorically to its original pressure. Compute the temperature at the beginning of the adiabatic expansion. Compute the temperature at the end of the adiabatic expansion. Compute the minimum pressure.

Fields 20.1

You build a heat engine that takes 1.80 mol of an ideal diatomic gas through the cycle shown in the figure below. Show that segment ab is an isothermal compression. During which segment(s) of the cycle is heat absorbed by the gas? During which segment(s) is heat rejected? Calculate the temperature at points a, b, and c. Calculate the *net* heat exchanged with the surroundings. Calculate the net work done by the engine in one cycle. Calculate the thermal efficiency of the engine.



Fields 20.2

Graph a Carnot cycle, plotting Kelvin temperature vertically and entropy horizontally. This is called a temperature-entropy diagram, or TS-diagram. Show that the area under any curve representing a reversible path in a temperature-entropy diagram represents the heat absorbed by the system. Derive from your diagram the expression for the thermal efficiency of a Carnot cycle. Draw a temperature-entropy diagram for the Stirling cycle shown in problem 20.52 in the book. Use this diagram to relate the efficiency of the Carnot and Stirling cycles.