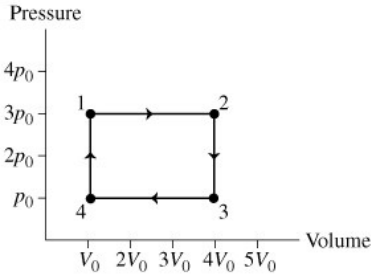
Problem 1

During the time 0.325 mol of an ideal gas undergoes an isothermal compression at 22.0 °C, 332 J of work is done on it by the surroundings. If the final pressure is 1.76 atm, what was the initial pressure?

Problem 2



The diagram shows the pressure and volume of an ideal gas during one cycle of an engine. As the gas proceeds from state 1 to state 2, it is heated at constant pressure. It is then cooled at constant volume, until it reaches state 3. The gas is then cooled at constant pressure to state 4. Finally, the gas is heated at constant volume until it returns to state 1. Use the constants V_0 and p_0 in your answers.

(a) Find W_{12}, the work done by the gas as it expands from state 1 to state 2.
(b) Find W_{23}, the work done by the gas as it cools from state 2 to state 3.
(c) Find W_{34}, the work done by the gas as it is compressed from state 3 to state 4.
(d) Find W_{41}, the work done by the gas as it is heated from state 4 to state 1.
(e) What is W_{net}, the total work done by the gas during one cycle?

Problem 3

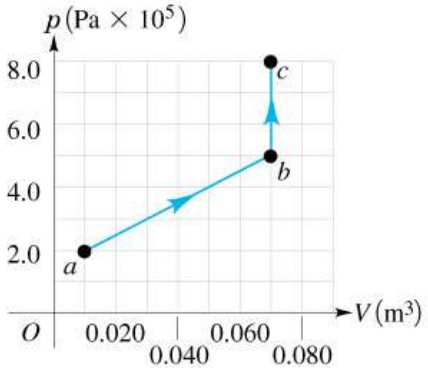
A gas in a cylinder is held at a constant pressure of 2.27×10^5 Pa and is cooled and compressed from a volume of 1.74 m^3 to 1.29 m^3. The internal energy of the gas decreases by 1.35×10^5 J.
(a) Find the work done by the gas.
(b) Find the absolute value $|Q|$ of the heat flow into or out of the gas.
(c) Is the heat flowing into the gas or out of the gas?

Problem 4

When water is boiled under a pressure of 2.00 atm, the heat of vaporization is 2.20×10^6 J/kg and the boiling point is 120 °C. At this pressure, 1.00 kg of water has a volume of 1.00×10^{-3} m^3, and 1.00 kg of steam has a volume of 0.824 m^3.
(a) Determine the work done when 1.00 kg of steam is formed at this temperature.
(b) Determine the increase in internal energy of the water.

Problem 5

The pV diagram in the figure shows a process *abc* involving 0.590 mol of an ideal gas.



(a) What was the temperature of this gas at points *a*, *b*, and *c*?
(b) How much work was done by or on the gas in this process?

(c) How much heat had to be put in during the process to increase the internal energy of the gas by 1.30×10^4 J?

Problem 6

During an isothermal compression of an ideal gas, 410J of heat must be removed from the gas to maintain constant temperature. How much work is done by the gas during the process?

Problem 7

A flexible balloon contains 0.315 mol of an unknown polyatomic gas. Initially the balloon containing the gas has a volume of 6850 cm^3 and a temperature of 27.0 °C. The gas first expands isobarically until the volume doubles. Then it expands adiabatically until the temperature returns to its initial value. Assume that the gas may be treated as an ideal gas with $C_p = 33.26$ J/mol·K and $\gamma = 4/3$.
(a) What is the total heat Q supplied to the gas in the process?
(b) What is the total change in the internal energy ΔU of the gas?
(c) What is the total work W done by the gas?

Problem 8

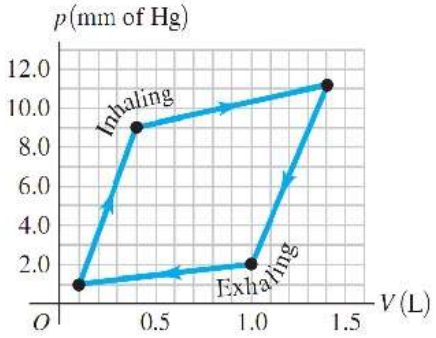
A player bounces a basketball on the floor, compressing it to 80.0% of its original volume. The air (assume it is essentially N_2 gas) inside the ball is originally at a temperature of 20.0 °C and a pressure of 2.00 atm. The ball's diameter is 23.9 cm.
(a) What temperature does the air in the ball reach at its maximum compression? Assume that the compression of the air during the bounce is adiabatic.
(b) By how much does the internal energy of the air change between the ball's original state and its maximum compression?

Problem 9

In a cylinder, 1.20mol of an ideal monatomic gas, initially at 3.60×105Pa and 300K, expands until its volume triples.
(a) Determine the work done by the gas if the expansion is isothermal.
(b) Determine the work done by the gas if the expansion is adiabatic.
(c) Determine the work done by the gas if the expansion is isobaric.

Problem 10

The graph shows a pV-diagram of the air in a human lung when a person is inhaling and then exhaling a deep breath. Such graphs, obtained in clinical practice, are normally somewhat curved, but we have modeled one as a set of straight lines of the same general shape. (Important: The pressure shown is the gauge pressure, not the absolute pressure.)



(a) How many joules of *net* work does this person's lung do during one complete breath?
(b) The process illustrated here is somewhat different from those we have been studying, because the pressure change is due to changes in the amount of gas in the lung, not to temperature changes. (Think of your own breathing. Your lungs do not expand because they've gotten hot.) If the temperature of the air in the lung remains a reasonable 20 °C, what is the maximum number of moles in this person's lung during a breath?