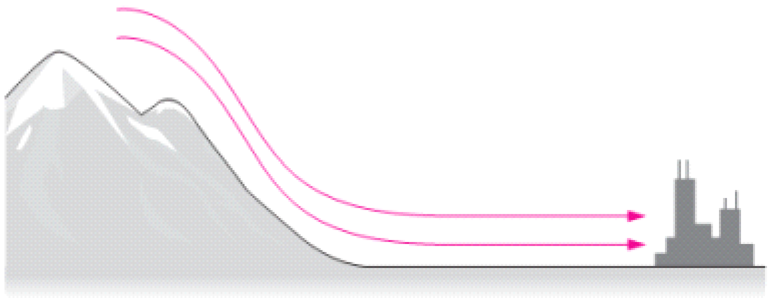
Section Six Laws of Thermodynamics

Part one

Warm winds called Chinooks (a Native-American term meaning " snow eaters") sometimes sweep across the plains just east of the Rocky Mountains. These winds carry air from high in the mountains down to the plains rapidly enough that the air has no time to exchange heat with its surroundings (Fig. 6.2). On a particular Chinook day, temperature and pressure high in the Colorado Rockies are 60 kPa and 260 K respectively; the plain below is at 90 kPa.



1. The process the air undergoes as it descends the mountains is
a. isothermal.
b. isovolumic. (constant volume)
c. isobaric. (constant pressure)
d. adiabatic
2. As the air descends, its internal energy
a. increases.
b. decreases.
c. is unchanged.
3. As the air descends, its volume
a. increases by 50%.
b. increases by less than 50%.
c. decreases by 50%.
d. decreases by less than 50%.
e. is unchanged.
4. When the air reaches the plain, its temperature is approximately
a. 240 K.
b. 260 K.
c. 290 K.
d. 390 K

Refrigerators remain among the greatest consumers of electrical energy in most homes, although mandated efficiency standards have de-creased their energy consumption by some 80% in the past four decades. In the course of a day, one kitchen refrigerator removes 30 MJ of energy from its contents, in the process consuming 10 MJ of electrical energy. The electricity comes from a 40% efficient coal-fired power plant.

5. The electrical energy
a. is used to run the light bulb inside the refrigerator.

b. wouldn't be necessary if the refrigerator had enough insulation.

c. retains its high-quality status after the refrigerator has used it.

d. ends up as waste heat rejected to the kitchen environment.

66. The refrigerator's COP is

a. 1/3

b. 2.

c. 3.

d. 4.

67. The fuel energy consumed at the power plant to run this refrigerator for the day is

a. 12 MJ.

b. 25 MJ.

c. 40 MJ.

d. 75 MJ.

68. The total energy rejected to the surrounding kitchen during the course of the day is

a. 10 MJ.

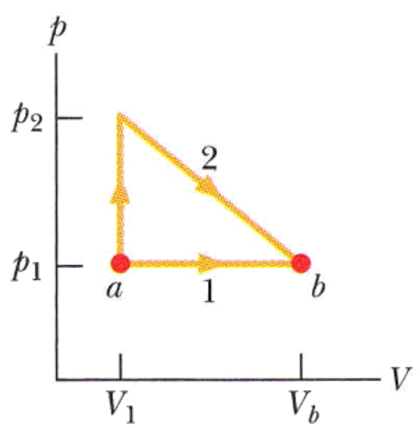
b. 30 MJ.

c. 40 MJ.

d. 75 MJ.

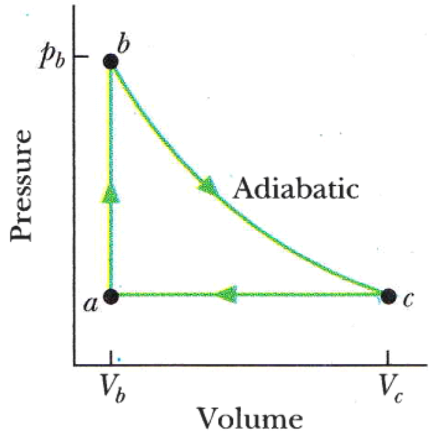
Part Two

1 The p-V diagram in Fig. 6.2 shows two paths along which a sample of gas can be taken from state a to state b where $V_b=3.0V_1$. Path 1 requires that energy equal to $5.0p_1V_1$ be transferred to the gas as heat. Path2 requires that energy equal to $5.5p_1V_1$ be transferred to the gas as heat. What is the ratio p2/p1



2 An ideal gas undergoes an adiabatic compression from p=1.0atm, V=1.0x10^{6}L, T=0.0℃ to p-1.0x10 ^{5}atm, V =1.0 x 10^3 L. (a) Is the gas monatomic, diatomic, or polyatomic? (b) What is its final temperature? (c) How many moles of gas are present? What is the total translational kinetic energy per mole (d) before and (e) after the compression? (f) What is the ratio of the squares of the rms speeds before and after the compression?

3 Figure 6.2 shows a reversible cycle through which 1.00 mol of a monatomic ideal gas is taken. Volume Vc=8.00V$_b$. Process bc is an adiabatic expansion, with p$_b$= 10.0 atm and Vu:1.00 X 10^{-3} m^3. For the cycle, find (a) the energy added to the gas as heat, (b) the energy leaving the gas as heat, (c) the net work done by the gas, and (d) the efficiency of the cycle.



4 What is the entropy change for 3.20 mol of an ideal monatomic gas undergoing a reversible increase in temperature from 380 K to 425 K at constant volume?