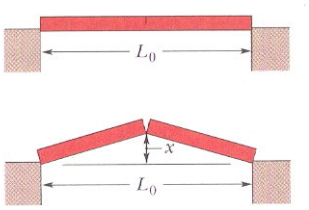
Chapter 18

21.
As a result of a temperature rise of 32ºC, a bar with a crack at its center buckles upward. If the fixed distance L_0 is 3.77 m and the coefficient of linear expansion of the bar is 25×10^{-6}/ºC, find the rise x of the center.

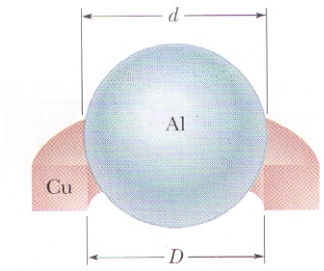


30.
A 150 g copper bowl contains 220 g of water, both at 20.0 ºC. A very hot 300 g copper cylinder is dropped into the water, causing the water to boil, with 5.00 g being converted to steam. The final temperature of the system is 100 ºC. Neglect energy transfer with the environment. (a) How much energy (in calories) is transferred to the water as heat? (b) How much to the bowl? (c) What is the original temperature of the cylinder?

37.
A person makes a quantity of iced tea by mixing 500 g of hot tea (essentially water) with an equal mass of ice at its melting point. Assume the mixture has negligible energy exchanges with its environment. If the tea's initial temperature is T_i = 90ºC, when thermal equilibrium is reached what are (a) the mixture's temperature T_f and (b) the remaining mass m_f of ice? If T_i = 70 ºC, when thermal equilibrium is reached what are (c) T_f and (d) m_f?

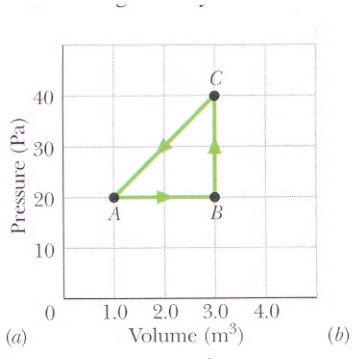
39.
(a) Two 50 g ice cubes are dropped into 200 g of water in a thermally insulated container. If the water is initially at 25 ºC, and the ice comes directly from the freezer at -15 ºC, what is the final temperature at thermal equilibrium? (b) What is the final temperature if only one ice cube is used?

41.
A 20.0 g copper ring at 0.000 ºC has an inner diameter of D = 2.54000 cm. An aluminum sphere at 100.0 ºC has a diameter of d= 2.54508 cm. The sphere is placed on top of the ring, and the two are allowed to come to thermal equilibrium, with no heat lost to the surroundings. The sphere just passes through the ring at the equilibrium temperature. What is the mass of the sphere?



42.
A thermodynamic system is taken from state A to state B to state C, and then back to A, as shown in the p-V diagram. (a)-(g) Complete the table by inserting a plus sign, a minus sign, or a zero in

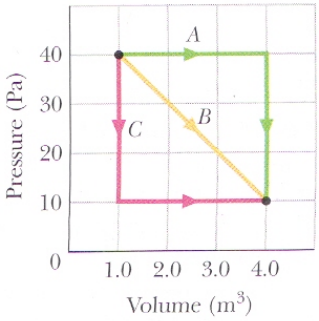
each indicated cell. (h) What is the net work done by the system as it moves once through the cycle ABCA?



(a) (b)

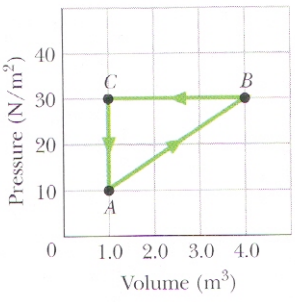
	Q	W	ΔE_{int}
$A \rightarrow B$	(a)	(b)	+
$B \rightarrow C$	+	(c)	(d)
$C \rightarrow A$	(e)	(f)	(g)

43.
A sample of gas expands from 1.0 m^3 to 4.0 m^3 while its pressure decreases from 40 Pa to 10 Pa. How much work is done by the gas if its pressure changes with volume via (a) path A, (b) path B, and (c) path C?

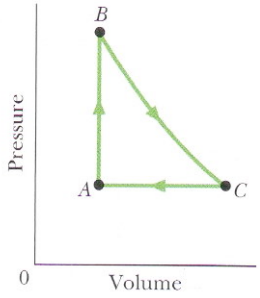


44.
Suppose 200 J of work is done on a system and 70.0 cal is extracted from the system as heat. In the sense of the first law of thermodynamics, what are the values (including algebraic signs) of (a) W, (b) Q, and (c) ΔE_{int}?

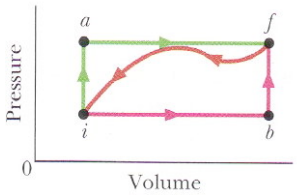
45.
A gas within a closed chamber undergoes the cycle shown in the p-V diagram. Calculate the net energy added to the system as heat during one complete cycle.



48.
Gas within a chamber passes through the cycle shown. Determine the energy transferred by the system as heat during the process CA if the energy added as heat Q_{AB} during process AB is 20.0 J, no energy is transferred as heat during process BC, and the net work done during the cycle is 15.0J.



49.
When a system is taken from state I to state f along path iaf, Q = 50cal and W = 20 cal. Along path ibf, Q = 36 cal. (a) What is W along path ibf? (b) If work = -13cal for the return path fi, what is Q for this path? (c) If $E_{int,i}$ = 10 cal, what is $E_{int,f}$? If $E_{int,b}$ is 22 cal, what is Q for (d) path ib and (e) path bf?



54.
A sphere of radius 0.500 m, temperature 27.0ºC, and emissivity 0.850 is located in an environment of temperature 77.0 ºC. At what rate does the sphere (a) emit and (b) absorb thermal radiation? (c) What is the sphere's net rate of energy exchange?

59.
The figure shows (in cross section) a wall consisting of four layers, with thermal conductivities k_1 = 0.060 W/mK, k_3 = 0.040 W/mK, and k_4 = 0.12 W/mK (k_2 is not known). The layer thicknesses are L_1 = 1.5 cm, L_3 = 2.8 cm, and L_4 = 3.5 cm (L_2 is not shown). Energy transfer through the wall is steady. What is the temperature of the interface between layers 3 and 4?