1. At very low temperatures, the molar specific heat c of many solids is approximately , where A depends on the particular substance. For aluminum J/mol.. Find the entropy change for 4.00 mol of aluminum when its temperature is raised from 5.00 K to 10.0 K.
2. A 364 g block is put in contact with a thermal reservoir. The block is initially at a lower temperature than the reservoir. Assume that the consequent transfer of energy as heat from the reservoir to the block is reversible. **Figure 1** gives the change in entropy of the block until thermal equilibrium is reached. The scale of the horizontal axis is set by and K.

What is the specific heat of the block?

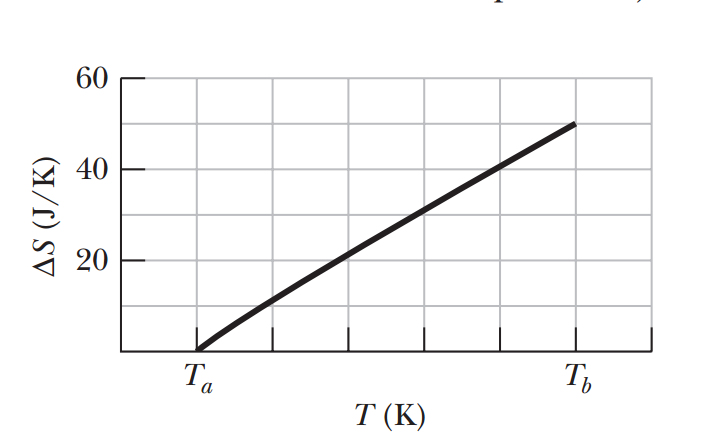


Figure 1.

1. In an experiment, 200 g of aluminum (with a specific heat of 900 J/kg.K) at 100°C is mixed with 50.0 g of water (specific heat of 4190 J/kg.K) at 20.0°C, with the mixture thermally isolated. (a) What is the equilibrium temperature? What are the entropy changes of (b) the aluminum, (c) the water, and (d) the aluminum–water system?
2. A gas sample undergoes a reversible isothermal expansion. **Figure 2** gives the change in entropy of the gas versus the final volume of the gas. The scale of the vertical axis is set by J/K.

How many moles are in the sample?

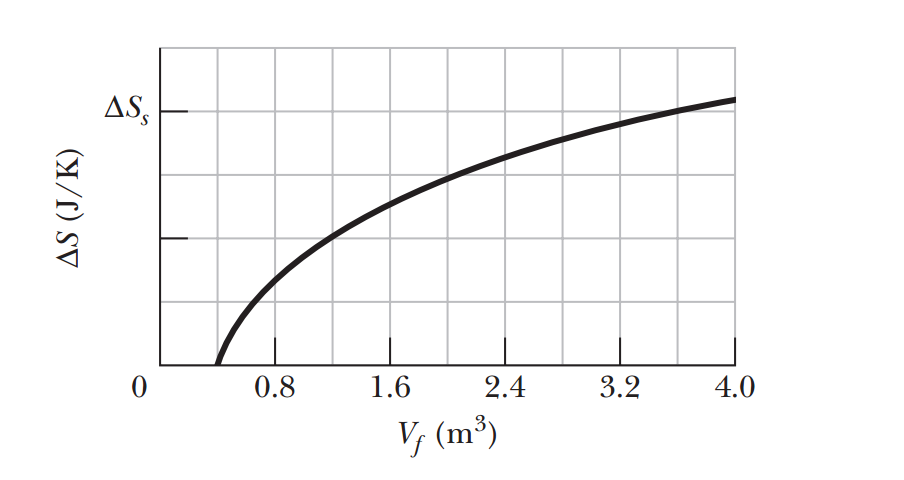


Figure 2.

1. One mol of a monatomic ideal gas taken through the cycle in **Figure 3**, where ,

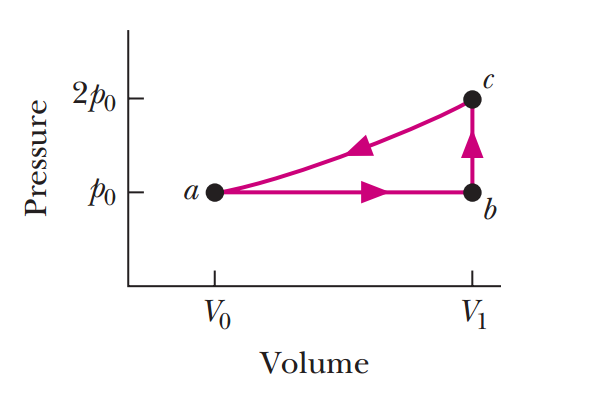


Figure 3.

1. what is as the gas goes from state a to state c along path abc?
2. What is in going from b to c and through one full cycle?
3. What is in going from b to c and through one full cycle?
4. A mixture of 1773 g of water and 227 g of ice is in an initial equilibrium state at 0°C. The mixture is then, in a reversible process, brought to a second equilibrium state where the water–ice ratio, by mass, is 1:1at 0°C.
5. Calculate the entropy change of the system during this process. (The heat of fusion for water is 333 kJ/kg).
6. The system is then returned to the initial equilibrium state in an irreversible process (say, by using a Bunsen burner). Calculate the entropy change of the system during this process.
7. Are your answers in part (a) consistent with the second law of thermodynamics?
8. The cycle in **Figure 4** represents the operation of a gaso line internal combustion engine. Volume . Assume the gasoline–air intake mixture is an ideal gas with 1.3.

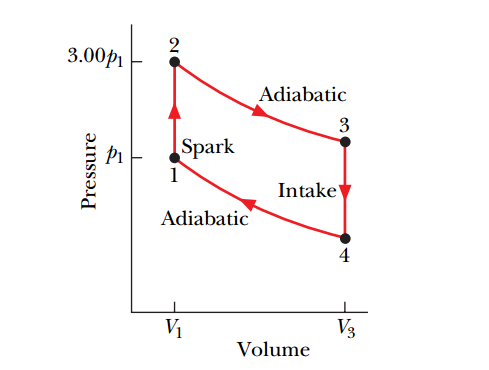


Figure 4.

What are the ratios

1. T2/T1.
2. T3/T1.
3. T4/T1.
4. p3/p1.
5. p4/p1.
6. One mol of an ideal gas is the working substance in an engine that operates on the cycle shown In **Figure 5**.

Processes BC and DA are reversible and adiabatic.

Is the gas monatomic, diatomic, or polyatomic?.

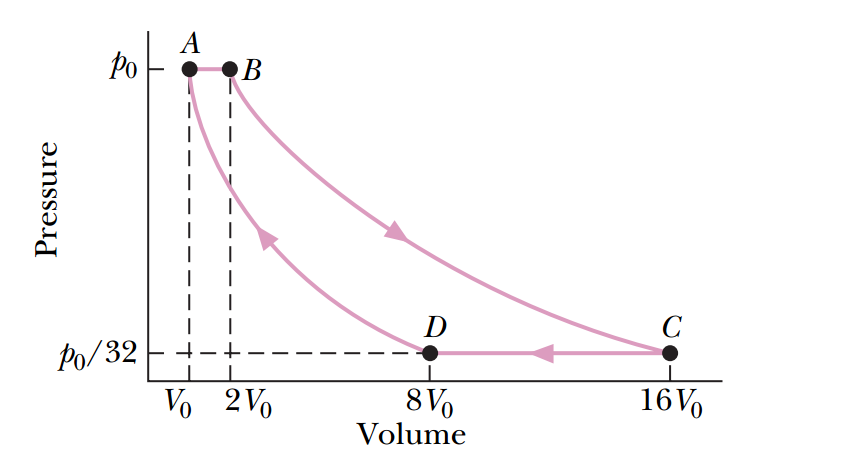


Figure 5.

1. 0.03675 J/K.
2. 450 J/kg.K.
3. (a) 59.97; (b) -22.06 J/K; (c) 24.89 J/K; (d) 2.83 J/K.
4. 3.5 mol.
5. (a) 3; (b) 6 and 0; (c) 2.84 J/K and 0 J/K.
6. (a) -942.89 J/K; (b) 942.89 J/K; (c) Hint: unclosed systems.
7. (a) 3; (b) 1.979; (c) 0.6597; (d) 0.4948; (e) 0.1649.
8. f = 3 monatomic