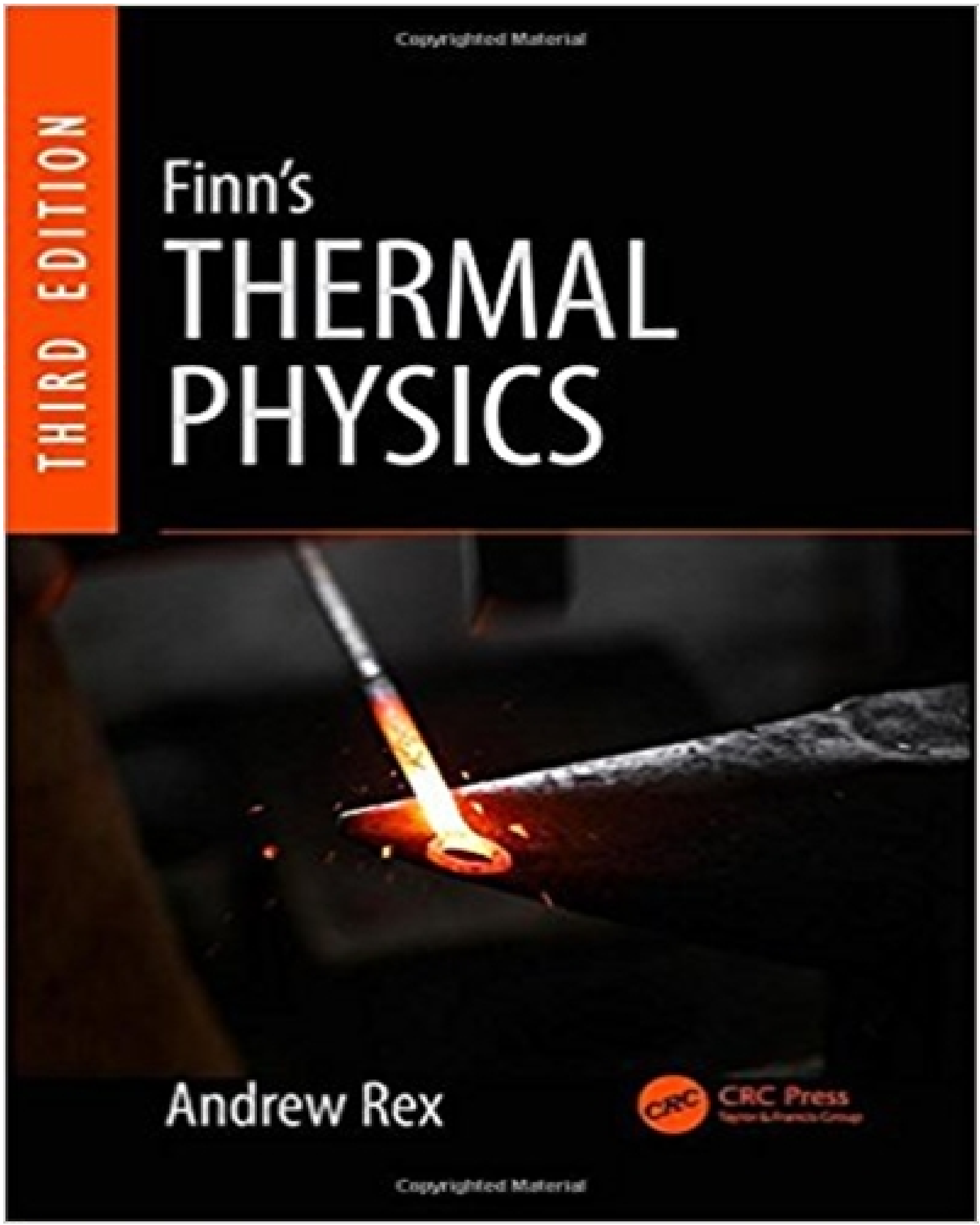
Solutions for Finn s Thermal Physics 3rd Edition by Rex

CLICK HERE TO ACCESS COMPLETE Solutions



Solutions

CLICK HERE TO ACCESS THE COMPLETE Solutions

Chapter 2

3. The contraction from the hottest day to coldest day is

$$\Delta L = \alpha L \Delta T = \left(1.2\times10^{-5}\ /°\text{C}\right)\left(15\ \text{m}\right)\left(-60°\text{C}\right) = -10.8\ \text{mm}$$

When added to the existing gap of 2.0 mm, this makes a net gap of 13 mm.

4. (a) From Equation 2.2, $V = \frac{\Delta V}{\beta \Delta T} = \frac{\pi r^2}{\beta}\frac{\Delta x}{\Delta T}$

for expansion by Δx in a tube of radius r. inserting the numerical values:

$$V = \frac{\pi r^2}{\beta}\frac{\Delta x}{\Delta T} = \frac{\pi\left(5\times10^{-5}\ \text{m}\right)^2}{49\times10^{-5}\ /°\text{C}}\frac{0.001\ \text{m}}{1°\text{C}} = 1.60\times10^{-8}\ \text{m}^3 = 1.6\times10^{-2}\ \text{cm}^3$$

This is small but reasonable given the size of the tube.
(b) Using the same formula but different expansion data:

$$V = \frac{\pi r^2}{\beta}\frac{\Delta x}{\Delta T} = \frac{\pi\left(5\times10^{-5}\ \text{m}\right)^2}{49\times10^{-5}\ /°\text{C}}\frac{0.02\ \text{m}}{1°\text{C}} = 3.2\times10^{-7}\ \text{m}^3 = 0.32\ \text{cm}^3$$

(c) For ethanol the expansion coefficient is now $\beta = 75\times10^{-5}\ /°\text{C}$, which is slightly higher than for mercury. Therefore the volumes must be slightly smaller.

Ordinary thermometer: $V = \frac{\pi r^2}{\beta}\frac{\Delta x}{\Delta T} = \frac{\pi\left(5\times10^{-5}\ \text{m}\right)^2}{75\times10^{-5}\ /°\text{C}}\frac{0.001\ \text{m}}{1°\text{C}} = 1.0\times10^{-8}\ \text{m}^3 = 1.0\times10^{-2}\ \text{cm}^3$

Medical thermometer: $V = \frac{\pi r^2}{\beta}\frac{\Delta x}{\Delta T} = \frac{\pi\left(5\times10^{-5}\ \text{m}\right)^2}{75\times10^{-5}\ /°\text{C}}\frac{0.02\ \text{m}}{1°\text{C}} = 2.1\times10^{-7}\ \text{m}^3 = 0.21\ \text{cm}^3$

6. The original gas volume is $V_0 = \frac{nRT}{P} = \frac{(2.0)(8.31\ \text{J/K})(300\ \text{K})}{101.3\times10^3\ \text{Pa}} = 0.04922\ \text{m}^3$

$$W_1 = -P\Delta V = -\left(101.3\times10^3\ \text{Pa}\right)\left(0.04922\ \text{m}^3\right) = -4986\ \text{J}$$

$W_2 = nRT\ln 2 = (2.0)(8.31\ \text{J/K})(600\ \text{K})(\ln 2) = 6912\ \text{J}$ (note T = 600 K after step 1)

$W_3 = 0$ (because there is no work, only heat)

$W_{\text{net}} = -4986\ \text{J} + 6912\ \text{J} = 1926\ \text{J}$

The net work is positive because the compression work is greater than that done by the gas in expansion.

7. (a) Using Equation 2.3

$$\Delta P = B\frac{\Delta V}{V} = \left(2.2\times10^9\ \text{N/m}^2\right)(0.01) = 2.2\times10^7\ \text{Pa}$$

(b) Initially the pressure is zero, and it increases gradually to the value found in part (a). Therefore the average pressure is half the final value. The initial volume of 10 kg of water is 10 L = 0.01 m^3, so $\Delta V = 10^{-4}$ m^3.

$$W = P_{\text{avg}}\Delta V = \left(1.1\times10^7\ \text{Pa}\right)\left(1.0\times10^{-4}\ \text{m}^3\right) = 1100\ \text{J}$$

This is equivalent to finding the area on the PV graph.