

Chapter 17 Problem 63 †

Given

$$T_i = 10\text{ }^\circ\text{C}$$

$$T_f = 25\text{ }^\circ\text{C}$$

$$V_f = 60\text{ L}$$

$$\beta = 95 \times 10^{-5}\text{ K}^{-1}$$

Solution

Find the volume placed in the tank which will not over flow when the gas warms up.

The volume expansion is given by

$$\beta = \frac{\Delta V/V}{\Delta T}$$

This leads to the formula

$$\Delta V = \beta V \Delta T$$

Now the initial volume plus the increased volume must equal 60 L.

$$V + \Delta V = 60\text{ L}$$

Substituting the first equation into the second gives

$$V + \beta V \Delta T = 60\text{ L}$$

$$V(1 + \beta \Delta T) = 60\text{ L}$$

Solving for V gives

$$V = \frac{60\text{ L}}{1 + \beta \Delta T} = \frac{60\text{ L}}{1 + (95 \times 10^{-5}\text{ K}^{-1})(25^\circ\text{C} - 10^\circ\text{C})}$$

$$V = 59.2\text{ L}$$

†Problem from Essential University Physics, Wolfson