

## Chapter 18 Problem 22 †

### Given

$$n = 0.30 \text{ mol}$$

$$T = 300 \text{ K}$$

$$V_f = 5V_i$$

### Solution

Find the work done during the isothermal expansion.

Work done by an idea gas is

$$W = \int_{V_i}^{V_f} P dV$$

However, pressure is a function of volume as determined by the ideal gas law.

$$P = \frac{nRT}{V}$$

Therefore, work becomes

$$W = \int_{V_i}^{V_f} \frac{nRT}{V} dV = nRT \ln \left( \frac{V_f}{V_i} \right)$$

Substituting in the given values

$$W = (0.30 \text{ mol})(8.31 \text{ J/mol} \cdot \text{K})(300 \text{ K}) \ln \left( \frac{5V_i}{V_i} \right)$$

$$W = 1204 \text{ J} = 1.2 \text{ kJ}$$

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†Problem from Essential University Physics, Wolfson