45. According to the first law of thermodynamics, $\Delta E_{\text{int}} = Q - W$. Since the process is isothermal $\Delta E_{\text{int}} = 0$ (the internal energy of an ideal gas depends only on the temperature) and $Q = W$. The work done by the gas as its volume expands from V_i to V_f at temperature T is

$$W = \int_{V_i}^{V_f} p\, dV = nRT \int_{V_i}^{V_f} \frac{dV}{V} = nRT \ln \frac{V_f}{V_i}$$

where the ideal gas law $pV = nRT$ was used to substitute for p. For 1 mole $Q = W = RT \ln(V_f / V_i)$.