Callen

4.2-3. The ideal gas equation reads

$$PV = NRT \implies P = \frac{NRT}{V}$$

The 1st law reads

$$dU = TdS - PdV, \quad \text{setting } dU = 0$$

$$TdS = PdV$$

$$\implies dS = \frac{NR\cancel{T}}{V\cancel{T}} dV$$

$$\implies \Delta S = NR \ln \frac{V_f}{V_i}$$