Callen.

4.4-1. $dS = \frac{dQ}{T} = \frac{1}{T}\frac{dQ}{dT}dT = \frac{c}{T}dT$.

$$\Delta S_1 = \int_{T_{01}}^{T_f} \frac{c}{T} dT, \quad \Delta S_2 = \int_{T_{02}}^{T_f} \frac{c}{T} dT.$$

$$\Delta U = \int_{T_{01}}^{T_{02}} \frac{dQ}{dT} dT = \int_{T_{01}}^{T_{02}} C\,dT$$

$$= 200A + 6\times10^4 B.$$

$$\int_{200}^{T_f} C\,dT = A(T_f - 200) + \frac{B}{2}(T_f^2 - 200^2) = 100A + 3\times10^4 B.$$

$$AT_f - 200A + \frac{B}{2}T_f^2 - B\times2\times10^4 = 100A + 3\times10^4 B.$$

$$\frac{B}{2}T_f^2 + AT_f = 300A + 5\times10^4 B.$$

$$\frac{B}{2}T_f^2 + AT_f + C = 0, \quad C = -(300A + 5\times10^4 B).$$
$$= -3400$$

$$\frac{-A \pm \sqrt{A^2 - 2BC}}{B} = \frac{-8 \pm \sqrt{64 + 136}}{2\times10^{-2}} = \cancel{192,} \; (-1107, 307)$$

We clearly take the 307 solution only. $\Rightarrow \boxed{T_f = 307\,k}$

$$\Delta S = \int_{200}^{307} \frac{c}{T} dT + \int_{400}^{307} \frac{c}{T} dT = A\ln\left(\frac{307}{200}\right) + B(307-200)$$
$$+ A\ln\left(\frac{307}{400}\right) + B(307-400).$$

$$= \cancel{Aln} \quad \simeq \boxed{1.0312}$$