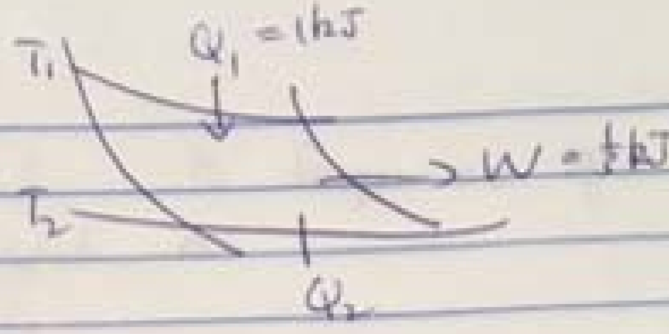
Homework Phy 4523

Chap. 2

5.



$$\frac{Q_2}{T_2} = \frac{Q_1}{T_1}$$

$$\therefore Q_2 = Q_1 \frac{T_2}{T_1} = \tfrac{2}{3} kJ$$

$$\therefore W = \tfrac{1}{3} kJ$$

8(a)

$x = T_B / T_A$

$$\left.\begin{array}{l} \Delta S_{system} = \int_{273}^{373} \frac{dQ}{T} = c \ln \frac{373}{273} = 0.312C \\ \Delta S_{Bath} = \frac{-100C}{373} = -0.268C \end{array}\right\} \Delta S_{univ} = 0.044C$$

(b) $$\Delta S_{system} = \int_{273}^{323} \frac{c\,dT}{T} + \int_{323}^{373} \frac{c\,dT}{T} = c\left[\ln \frac{323}{273} + \ln \frac{373}{323}\right] = c \ln \frac{373}{273}$$

= Same as (a)

$$\Delta S^1_{Bath} + \Delta S^2_{Bath} = -50C\left[\frac{1}{323} + \frac{1}{373}\right] = -0.155C$$

$$\underline{\Delta S_{univ} = 0.023C}$$

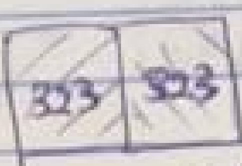
(c) ΔS_{system} same

$$\Delta S^1_{Bath} + \Delta S^2_{Bath} + \Delta S^3_{Bath} + \Delta S^4_{Bath} = -25C\left[\frac{1}{298} + \frac{1}{323} + \frac{1}{348} + \frac{1}{37\ldots}\right.$$

$= -0.350$

$$\underline{\Delta S_{Univ.} = +0.02C}$$

9. $C = \text{constan}$



$$\Delta S = \underbrace{\int_{373}^{323} \frac{c\,dT}{T}}_{\text{Blk A}} + \underbrace{\int_{273}^{323} \frac{c\,dT}{T}}_{\text{Blk B}} = c\ln\frac{323}{373} + c\ln\frac{3}{3}$$

$$= c\ln\left(\frac{323^2}{273\times 373}\right) = 0.024\,C.$$

10. $$\Delta S = \int \frac{c\,dT}{T} = \int \frac{aT + bT^3}{T}\,dT = \int (a + bT^2)\,dT$$

$$= aT + \tfrac{1}{3}bT^3.$$

16 $Q = 50W.$ $\quad Q = C\Delta T \quad \Delta T = \frac{50}{.24} = 208.$

$$\Delta S = \int \frac{dQ}{T} = c\ln\frac{T_F}{T_I} = 0.24\ln\frac{508}{300} = 0.127\ J$$

18. Maxwell relation #1

$$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V \qquad S = S(V, T)$$

$$dS = \left(\frac{\partial S}{\partial V}\right)_T dV + \left(\frac{\partial S}{\partial T}\right)_V dT = \left(\frac{\partial P}{\partial T}\right)_V dV + \frac{C_v}{T}d$$

or $$T\,dS = C_v\,dT + T\left(\frac{\partial P}{\partial T}\right)_V dV$$

18. Maxwell relation #2

$$\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial P}\right)_T$$

$S(P,T)$

$$dS = \left(\frac{\partial S}{\partial T}\right)_P dT + \left(\frac{\partial S}{\partial P}\right)_T dP$$

$$= \frac{C_p}{T} dT - \left(\frac{\partial V}{\partial T}\right)_P dP$$

$$TdS = C_p dT - \left(\frac{\partial V}{\partial T}\right)_P dP$$

$$du = TdS - PdV$$

$$\left(\frac{\partial u}{\partial V}\right)_T = T\left(\frac{\partial S}{\partial V}\right)_T - P$$

$$= T\left(\frac{\partial P}{\partial T}\right)_V - P$$

using Max relation #

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20. $dU = TdS + \gamma dA$

$F = U - TS$ $\qquad dF = \gamma dA - SdT$

$F(S,A)$ function of state

Consider $dF = \left(\frac{\partial F}{\partial S}\right)_A dS + \left(\frac{\partial F}{\partial A}\right)_S dA$

$$\frac{\partial}{\partial A}\left(\frac{\partial F}{\partial T}\right)_A = -\frac{\partial S}{\partial A} = \frac{\partial}{\partial T}\left(\frac{\partial F}{\partial A}\right)_T = \frac{\partial \gamma}{\partial T}$$

Hence $\left.\frac{\partial S}{\partial A}\right)_T = -\left.\frac{\partial \gamma}{\partial T}\right)_A$ $\qquad dS = -\left(\frac{\partial \gamma}{\partial T}\right)_A$

$$\therefore \quad dU = -T\left(\frac{\partial \gamma}{\partial T}\right)_A dA + \gamma dA$$

$$= \left(\gamma - T\frac{\partial \gamma}{\partial T}\right)_A dA$$

$$U = \left[\gamma - T\left(\frac{\partial \gamma}{\partial T}\right)_A\right] A + \underline{\text{constant}}$$