№ 5.16

Дано:

$T = 273\,К$

$P = 100\,атм$

$\alpha = 1{,}81 \cdot 10^{-4}\ {}^\circ C^{-1}$

$c_p = 0{,}033\ \frac{кал}{г \cdot {}^\circ C}$

$\rho = 13{,}6\ \frac{г}{см^3}$

Решение:

$$\alpha = V^{-1}\left(\frac{\partial V}{\partial T}\right)_S$$

$$c_p = \left(\frac{\partial Q}{\partial T}\right)_p = \left(\frac{T\partial S}{\partial T}\right)_p = T\left(\frac{\partial S}{\partial T}\right)_p$$

$$\int dT = \int\left(\frac{\partial T}{\partial p}\right)_S dp$$

$$c_p = \left(\frac{T\partial S}{\partial T}\right)_p = T\left(\frac{\partial S}{\partial T}\right)_p$$

$$\left(\frac{\partial T}{\partial p}\right)_S \cdot \underbrace{\left(\frac{\partial S}{\partial T}\right)_p}_{c_p} \left(\frac{\partial p}{\partial S}\right)_T = -1$$

$$dU = TdS - pdV$$

$$d(U - TS + pV) = d\overset{\cancel{TdS} - \cancel{pdV}}{U} - \cancel{TdS} - SdT + \cancel{pdV} + Vdp = Vdp - SdT$$

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

$$\left(\frac{\partial T}{}\right) \quad \left(\frac{\partial V}{}\right) \quad T \quad = \alpha V T$$

$$\left(\frac{\partial T}{\partial p}\right)_S = \left(\frac{\partial V}{\partial T}\right)_p \cdot \frac{\quad}{c_p} \qquad \frac{\alpha V T}{c_p}$$

$$\int dT = \frac{\alpha V T}{c_p} \int dp$$

$$\Delta T = \frac{\alpha V T}{c_p} \cdot 99 \cdot 10^5$$

№ 5.40

Дано:

$P = \rho / 3$

$\rho = a T^4$

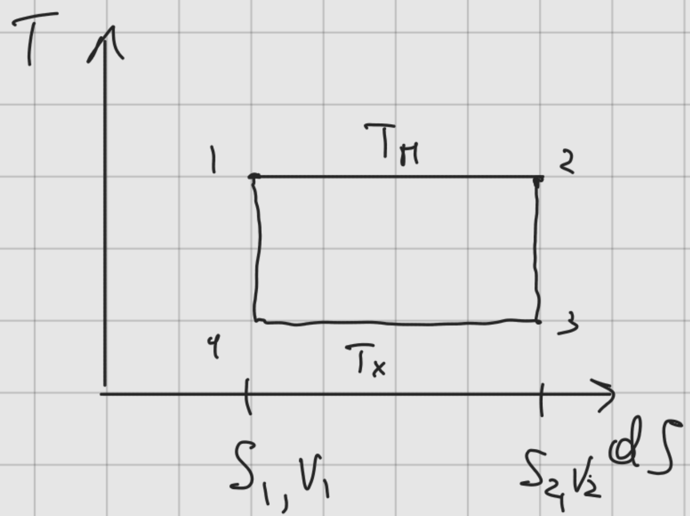
Найти:

A

Решение:

$$U = a T^4 V$$

$$P = \frac{a T^4}{3}$$



$$T^3 V = const$$

$$S = \frac{4}{3} a T^3 V$$

1) $Q_х = T_х \cdot (S_1 - S_2) = T_х^4 \cdot \frac{4}{3} a (V_1 - V_2)$

$$Q_н = T_н (S_2 - S_1)$$

$$\eta = 1 + \frac{Q_х}{Q_н} = \frac{A}{Q_н} \Rightarrow A = Q_н \left(1 - \frac{T_х}{T_н}\right) = Q_н T_н (T_н - T_х)$$

$$= A = Q_н - Q_х = (T_н - T_х) \cdot \frac{4}{3} a T_х^3 (V_2 - V_1)$$

$=$

№ 1.3(4)

Дано:

$\alpha = 1{,}8\cdot10^{-4}\,°C$, $T=273$

$\beta = 3{,}9\cdot10^{-6}$

Найти: λ

Решение:

$$\alpha_p = V^{-1}\left(\frac{\partial V}{\partial T}\right)_p \qquad \lambda = \frac{1}{p}\left(\frac{\partial p}{\partial T}\right)_V$$

$$-\beta = V^{-1}\left(\frac{\partial V}{\partial p}\right)_T$$

$$\overset{\alpha_p V}{\left(\frac{\partial V}{\partial T}\right)_p}\cdot\overset{\frac{1}{\beta V}}{\left(\frac{\partial p}{\partial V}\right)_T}\cdot\overset{\lambda p}{\left(\frac{\partial T}{\partial p}\right)_V} = -1$$

$$\alpha_p\cdot\lambda p = \beta = \qquad \lambda = \frac{\alpha_p}{\beta p}$$

№10

$f = aT\left(\frac{l}{l_0}\ \left(\frac{l_0}{l}\right)^2\right)$

$a = 1{,}3\cdot10^{-2}\ \frac{Н}{К}$

$l_0 = 1\,м$

$$F = U - TS$$

$$dF = \underset{-pdV+TdS}{dU} - TdS - SdT = -\overset{=0}{SdT} - pdV$$

$$dF = f \qquad \delta A = pdV$$

$$\delta A = -fdl$$

$$dF = -pdV$$

$$-p = \left(\frac{\partial F}{\partial V}\right)_T$$

$$\left(\frac{\partial F}{\partial l}\right)_T = f$$

$$\Delta F = \int f\,dl = aT\int\frac{l}{l_0}\,dl - \int\frac{l_0^2}{l^2}\,dl =$$

$$= aT l^2 \Big|^2 \qquad l_0 \Big|^2 \quad aT l_0$$

$$= \frac{\text{[illegible]}}{2 e_0}\Big|_1 + \frac{\text{[illegible]}}{e}\Big|_1 \text{[illegible]}$$

$$\left(\frac{\partial u}{\partial e}\right)_T = T\left(-\left(\frac{\partial f}{\partial T}\right)_e + \frac{f}{T}\right) = 0$$