Мещеряков Всеволод Б02-001 22.03.21

№3 $P = A(V) \cdot T$

соотн. Максвелла

$$\left(\frac{\partial Q}{\partial V}\right)_T = \left(\frac{T\partial S}{\partial V}\right)_T = T\left(\frac{dS}{dV}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V$$

$$= T\cdot\left(\frac{d(A(V)\cdot T)}{dT}\right)_V = T\cdot A(V) = \frac{T\cdot P}{T} = P$$

$$\left(\frac{\partial C_V}{\partial V}\right)_T = \cancel{\ldots}$$ +

формула из ДЗ

$$C_V = \left(\frac{dU}{dT}\right)_V = T\left(\frac{dP}{dT}\right)_V - P = T\cdot A(V) - T\cdot A(V)$$

$$\to C_V = 0 \longrightarrow \left(\frac{\partial C_V}{\partial V}\right)_T = 0.$$

Ответ: $\left(\frac{\partial Q}{\partial V}\right)_T = P$, $\left(\frac{\partial C_V}{\partial V}\right)_T = 0$.

хор(7)

0	0	+	+	+

№5

Поднятие поршня - адиабата (по усл. медленно => квазистат.) Внутри ид. газ:

$$PV^\gamma = const \Rightarrow \begin{cases} P_1V_0 = \nu RT_1 \\ P_2 nV_0 = \nu RT_2 \end{cases} \to T_2 = T_1 n^{1-\gamma}$$

T_2 - темпер. на высоте.

Опускается - падает - не квазистатич. Можем восп. ЗСЭ:

$$\frac{i}{2}\nu RT_2 + mgH = \frac{i}{2}\nu RT_3 + mgh,\ \text{где}$$

H - высота подъема, h - высота, на которой остановится, T_3 - искомая темп.

Из усл. равновесия $mgH = P_1\cdot(nV_0)$
$mgh = P_1\cdot(V_3)$

V_3 – объем в конечном сост.

$$\frac{i+2}{i} = \gamma \rightarrow i+2 = \gamma \cdot i \rightarrow i = \frac{2}{\gamma - 1}$$

$$\frac{\nu R T_1 n^{1-\gamma}}{\gamma - 1} + P_1 n V_0 = \frac{\nu R T_3}{\gamma - 1} + P_1 V_3$$

$$\begin{cases} P_1 V_1 = \nu R T_1 \\ P_3 V_3 = \nu R T_3 \end{cases} \xrightarrow{(P_3 = P_1)} P_1 V_3 = \nu R T_3$$

$$\frac{\nu R T_1 n^{1-\gamma}}{\gamma - 1} + \underbrace{P_1 n V_0}_{n \nu R T_1} = \nu R T_3 \left(\frac{1}{\gamma - 1} + 1 \right)$$

$$\cancel{\nu R} T_1 \left(\frac{n^{1-\gamma}}{\gamma - 1} + n \right) = \cancel{\nu R} T_3 \left(\frac{\gamma}{\gamma - 1} \right)$$

$$T_3 = \frac{\gamma - 1}{\gamma} \left(\frac{n^{1-\gamma}}{\gamma - 1} + n \right).$$

Ответ: $T_3 = \frac{\gamma - 1}{\gamma} \left(\frac{n^{1-\gamma}}{\gamma - 1} + n \right)$

T_1

+

№4 $T = 1^\circ C$, $\frac{\Delta V}{V} = 0{,}5\%$, $C_p \approx C_V$; $\Delta T = ?$

$\cancel{\text{Адиабата} \Rightarrow dS = 0}$

$\cancel{dS = C_V m \frac{dT}{T} + \left(\frac{\partial P}{\partial T}\right)_V dV = 0}$

$\cancel{\Rightarrow C_V m \int_T^{T+dT} \frac{dT}{T} = -\left(\frac{\partial P}{\partial T}\right)_V \int_V^{V+\Delta V} dV}$

$\cancel{\Rightarrow C_V m \ln\left(\frac{T+dT}{T}\right) = \left(\frac{\partial P}{\partial T}\right)_V (\Delta V)}$

$\cancel{\alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_p, \quad \beta_S = -\frac{1}{\Delta V}\left(\frac{\partial V}{\partial P}\right)_T}$

$\cancel{\Rightarrow \beta_S = \frac{-\alpha \Delta V}{C_V m \ln(1 + dT/T)}}$

полный дифф.

$$dT = \left(\frac{\partial T}{\partial V}\right)_S dV + \left(\frac{\partial S}{\partial S}\right)_V \delta V \Rightarrow$$

Адиабат. проц $\Rightarrow$ $dT = \left(\frac{\partial T}{\partial V}\right)_S dV$.

$$\left(\frac{\partial T}{\partial V}\right)_S \underset{\text{Максвелл}}{=} -\left(\frac{\partial P}{\partial S}\right)_V \underset{\text{частн. произв.}}{=} -\left(\frac{\partial T}{\partial S}\right)_V \cdot \left(\frac{\partial P}{\partial T}\right)_V$$

$$\frac{\alpha}{\beta} = \left(\frac{\partial V}{\partial T}\right)_p \cdot \left(\frac{\partial P}{\partial V}\right)_T = -\left(\frac{\partial P}{\partial T}\right)_V \longrightarrow \left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial T}{\partial S}\right)_V \cdot \left(\frac{\alpha}{\beta}\right)$$

$$C_V \approx C_p \approx C \Rightarrow C_V = \left(\frac{\delta Q}{\partial T}\right)_V = T\left(\frac{\partial S}{\partial T}\right)_V$$

$$\rightarrow \left(\frac{\partial T}{\partial S}\right)_V = \frac{T}{C} \longrightarrow \left(\frac{\partial T}{\partial V}\right)_S = -\frac{T}{C} \cdot \frac{\alpha}{\beta}$$

$$\rightarrow dT = -\frac{\alpha T}{\beta C} \cdot dV \longrightarrow \boxed{\Delta T = -\frac{\alpha T}{\beta C} (\Delta V)}$$

+

~~№1. [illegible]~~ дописать.

~~Расширение в вакуум~~

~~=> Работа не совершается~~

~~=> $\Delta U = 0$ [illegible]~~

№2.