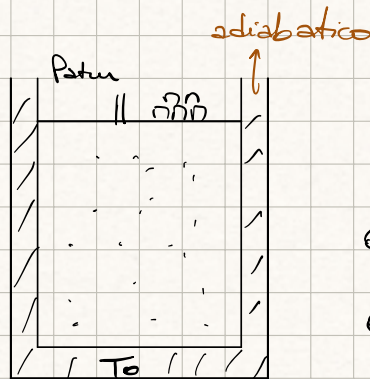


prima parte

2) $n = 10 \text{ mol}$
 $V_i = 1 \text{ m}^3$
 $V_f < V_i$
 $m = 0,1 \text{ kg}$
 $T_0 = 0^\circ\text{C}$
 $\lambda_F = 80 \text{ Kcal/kg}$



COMPRESSIONE ISOTERMA
REVERSIBILE passa per ∞ stati di equilibrio \Rightarrow processo lento
 $\hookrightarrow T_{\text{cost}}$

$$Q_{\text{ext}} = 0$$

$$Q_G + Q_S = 0$$

$< 0 \quad > 0$

$$Q_G = \cancel{\Delta U} + \cancel{d} \Rightarrow \cancel{d} = Q_G = -Q_S \quad ; \quad Q_S = m\lambda_F = 8 \text{ Kcal} = 33,5 \text{ kJ}$$

\downarrow
 $n c_v \Delta T = 0$
 < 0

$$\Rightarrow \cancel{d} = -Q_S = -33,5 \text{ kJ}$$

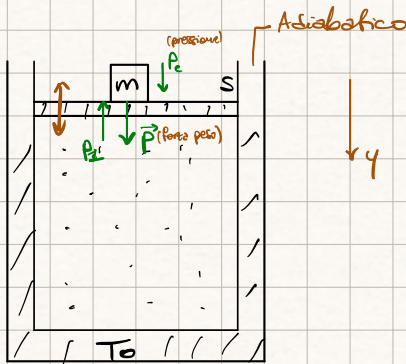
$$\cancel{d} = \int p dV \quad ; \quad pV = \frac{nRT}{\text{costanti}} = \text{cost} \quad (\text{legge di Boyle})$$

$$\Rightarrow p_i V_i = p_f V_f$$

$$\Rightarrow \cancel{d} = \int \frac{nRT}{V} dV = nRT \int \frac{1}{V} dV = nRT \ln \frac{V_f}{V_i} \quad \begin{matrix} < 0 & \text{infatti } V_f < V_i \Rightarrow \frac{V_f}{V_i} < 1 \Rightarrow \ln(\cdot) < 0 \end{matrix} = -Q = -m\lambda_F$$

$$\Rightarrow V_f = V_i e^{-\frac{m\lambda_F}{nRT}} \approx 0,23 \text{ m}^3 < V_i$$

- 3) $n = 2 \text{ mol}$
 MONOATOMICO
 $S = 10 \text{ cm}^2$
 $m = 20 \text{ kg}$
 $T = 100 \text{ K}$
 $P_e = 10^5 \text{ Pa} = 1 \text{ atm}$



- Successivamente:
 b) tolgo blocco
 ↳ ESPANSIONE: (irreversibile)
 nuovo equilibrio a P_e

? T_2

→ ESPANSIONE ADIABATICA
 IRREVERSIBILE

a) ? V_i

Il pistone è in equilibrio
 ↳ fermato + meccanico

BILANCIO FORZE: $mg + P_e S - P_i S = 0$

$$P_i = \frac{mg}{S} + P_e \approx 2,86 \cdot 10^5 \text{ Pa}$$

$$P_i V_i = nRT_1 \Rightarrow V_i = \frac{nRT_1}{P_i} \approx 5,6 \cdot 10^{-3} \text{ m}^3$$

b) ~~$PV^r = \text{cost}$~~ NO

ma vale sempre: $PV = nRT$; $Q = \Delta + \Delta U = 0$ perché adiabatico

$$\Delta = \Delta U = -n c_v (T_2 - T_1)$$

$$\delta \Delta = P_e dV \Rightarrow \Delta = \int_{V_1}^{V_2} P_e dV = P_e \int_{V_1}^{V_2} dV = P_e \Delta V \quad > 0 \text{ (espansione)}$$

$$\Rightarrow \Delta = n c_v (T_1 - T_2) = P_2 (V_2 - V_1)$$

↳ $T_2 < T_1$
 ↳ monoatomico: $= \frac{3}{2} R$

$$P_2 V_2 = nRT_2$$

$$\left. \begin{array}{l} n c_v (T_1 - T_2) = P_2 (V_2 - V_1) \\ P_2 V_2 = nRT_2 \end{array} \right\} \Rightarrow \left\{ \begin{array}{l} n c_v (T_1 - T_2) = P_2 (V_2 - V_1) \\ V_2 = \frac{nRT_2}{P_2} \end{array} \right.$$

$$\Rightarrow P_2 \left(\frac{nRT_2}{P_2} - \frac{nRT_1}{P_1} \right) = n c_v (T_1 - T_2)$$

$$\Rightarrow T_2 = \frac{3P_1 + 2P_e}{5P_1} \cdot T_1 \approx 73,5 \text{ K} < T_1$$

The diagram shows a rectangular container divided into two horizontal chambers, A (bottom) and B (top), by a thin horizontal line. Chamber B contains several small circles representing particles and is labeled with n_B/V_B . Chamber A also contains particles and is labeled with n_A/V_A . A vertical double-headed arrow is positioned between the two chambers. To the right of the chambers, a vertical spring is shown, with an arrow pointing left labeled Q . Below the chambers is a light blue rectangular area labeled T_0 and "termostato". Handwritten orange text "scambio calore" is on the left, and "scambio calore (assorto)" is on the right.

BIATOMICO

$$P_0 = 1 \text{ ster}$$

$$T_0 = 300K$$

$$C_v = \frac{5}{2} R$$

e) $?V_0$

b) $P_e = 1,3 \text{ atm}$

? $V_{f,4}$, ? $V_{f,8}$

REVERSIBLE

c) \mathbb{Q}_A ($< 0 > 0$?)

d) $?Q_B$

b) TRASFORMAZIONE REVERSIBILE GENERICA (B)

TRASFORMAZIONE ISOTERMA (A) - REVERSIBILE

$$T_A = T_0 = \text{cost} \quad ; \quad P_A V_A = \text{cost}$$

$$\Rightarrow P_0 V_0 = P_f V_{Af} \quad \Rightarrow V_{Af} = \frac{P_0 V_0}{P_f} \approx 2,27 \cdot 10^{-3} \text{ m}^3 < V_0$$

$$V_{Bf} = 2V_0 - V_{Af} = 3,63 \cdot 10^{-2} \text{ m}^3 > V_0 \text{ (expande)}$$

c) GAS B: $Q_B > 0$ (assorbe calore dalla resistenza termica)
 $\Rightarrow \underbrace{J_B}_{>0} + \underbrace{\Delta U_B}_{\text{"ncv} \Delta T > 0} > 0$

$$Q_A = \underbrace{J_A}_{\text{(Substanzfluss)}} + \underbrace{\Delta \cancel{U}}_{\substack{\text{Isotermie} \\ \Delta T = 0}}$$

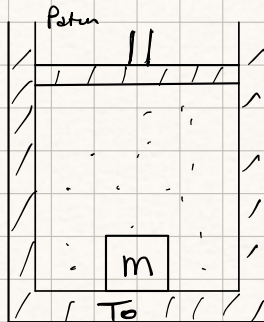
$$Q_A = \int P_A dV = \int \frac{nRT_A}{V_A} dV = nRT_0 \int_{\frac{1}{V_0}}^{\frac{1}{V_A}} dV = nRT_0 \ln\left(\frac{V_A}{V_0}\right) = Q_A = -785 \text{ J}$$

A cede calore al serbatoio

$$d) Q_B = \overset{>0}{2_B} + \underset{\substack{\parallel \\ -2_A}}{\Delta U_B} = -2A + ncv \left(\frac{p_f V_{pf}}{nR} - T_0 \right) \approx 5,2 \cdot 10^3 \text{ J}$$

$$T_{BF} = \frac{A_F V_{OF}}{nR}$$

5) $C_m = 1 \text{ J/}^\circ\text{C}$
 $T_m = 100^\circ\text{C}$
 $n = 1 \text{ mol}$
 MONOATOMICO
 $T_a = 25^\circ\text{C}$



a) ISOCORA

$$\Delta V = 0$$

$$Q_{ext} = 0$$

$$Q_G + Q_m = 0$$

$$Q_m = C_m(T_{eq} - T_m) = -Q_G = -\Delta U_G = -nC_V(T_{eq} - T_a)$$

$$Q_G = \cancel{\Delta U} + \Delta U$$

$\Delta V = 0$

$$\Rightarrow T_{eq} = \frac{C_m T_m + nC_V T_a}{C_m + nC_V} = 303,7 \text{ K}$$

b) $Q_m = C_m(T_{eq} - T_m) = -68,44 \text{ J}$

a) ? T_{eq} con pistone fermo

b) ? Q

Pistone libero c) ? T_{eq}

d) ? Q_G in entrambi i casi

c) ESPANSIONE IRREVERSIBILE (LIBERA)

$$\Delta U = Q_G = -Q_m = -C_m(T_{eq} - T_m)$$

$$\Delta U = \int p_e dV = p_e \Delta V = p_e (V_f - V_i) = nR(T_{eq} - T_a)$$

$p_e V_f = nRT_{eq}$ $p_e V_i = nRT_a$

$$\Rightarrow nR(T_{eq} - T_a) + nC_V(T_{eq} - T_a) = C_m(T_m - T_{eq})$$

$$\Rightarrow n(T_{eq} - T_a)(\underbrace{C_V + R}_{C_p}) = C_m(T_m - T_{eq}) \quad (= Q_G)$$

\hookrightarrow se pressione esterna cost

$$\Rightarrow T_{eq} = \frac{C_m T_m + nC_p T_a}{C_m + nC_p} = 301,65 \text{ K} < \text{caso a)}$$

d) caso 2: $Q_G = nR(T_{eq} - T_a) = 28,1 \text{ J}$

caso 1: $Q_G = 0$ perché pistone fermo $\Rightarrow \Delta V = 0$

XCAPA es 6:

Δ = area sottesa

$$dU = \int p dV$$

$$C_{AB} = \frac{1}{n} \frac{dQ}{dT}$$