Exercice 7 — Recipient calorifugé

Gaz Parfait $\gamma = 1,4$

$V_1 = 5\,l$ $\quad V_2 = ?$

$T_1 = 298\,K$ $\quad T_2 = ?$

$P_1 = 1\,bar$ $\quad P_2 = 10\,bar$

1) Adiabatique quasi-statique => reversible

$Q = 0$

$P_1 V_1 = n R T_1$

$n = \dfrac{P_1 V_1}{R T_1}$

$n = \dfrac{10^5 \times 5 \times 10^{-3}}{8,314 \times 298} = 0,2$ mole

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Quasistatique donc on peut utiliser les lois de Laplace.

$P_1 V_1^{\gamma} = P_2 V_2^{\gamma}$

$V_2^{\gamma} = \dfrac{P_1}{P_2} V_1^{\gamma}$

$V_2 = \left(\dfrac{P_1}{P_2}\right)^{\frac{1}{\gamma}} V_1$

$V_2 = \left(\dfrac{10^5}{10^6}\right)^{\frac{1}{1,4}} \times 5 \times 10^{-3}$

$= 9,65 \times 10^{-4}$

$= 0,965\,l$

$$P_1 V_1 = n R T_1$$
$$P_2 V_2 = n R T_2$$

$$\Leftrightarrow \quad \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\Leftrightarrow \quad \frac{P_2 V_2 T_1}{P_1 V_1} = T_2$$

$$\Leftrightarrow \quad \frac{10^5 \times 9{,}65 \times 10^{-4} \times 298}{10^5 \times 5 \times 10^{-3}} = 575{,}14 \text{ K}$$

2) $P_3 = 10$ bar

$T_3 = ?$

$V_3 = ?$

~~Quasistatique~~ → Brutale

≠ réversible

Adiabatique $Q = 0$

$$\Delta U = W = C_v \Delta T$$

$$= \frac{nR}{\gamma - 1} (T_3 - T_1)$$

$$W = -P_3 dV$$

$$= -P_3 (V_3 - V_1)$$

$$\frac{nR(T_3 - T_1)}{\gamma - 1} = -P(V_3 - V_1)$$

$$\Leftrightarrow \quad \frac{nRT_3}{\gamma - 1} - \frac{nRT_1}{\gamma - 1} = -P_3(V_3 - V_1)$$

$$\Leftrightarrow \quad nRT_3 - nRT_1 = -P_3(V_3 - V_1)(\gamma - 1)$$

$$\Leftrightarrow \quad P_3 V_3 - P_1 V_1 = -P_3(V_3 - V_1)(\gamma - 1)$$

$$\Leftrightarrow \quad p_3 V_3 - p_1 V_1 = -(\gamma - 1)(p_3 V_3 - p_2 V_1)$$

$$\Leftrightarrow \quad p_3 V_3 - p_3 V_3(\gamma - 1) = p_1 V_1 + p_2 V_1(\gamma - 1)$$

$$\Leftrightarrow \quad p_2 V_2(\gamma - 1 + 1) = V_1((\gamma - 1) p_2 + p_1)$$

$$\Leftrightarrow \quad V_3 = V_1 \frac{(\gamma - 1) p_3 + p_1}{\gamma p_3}$$

$$\Leftrightarrow \quad 5 \times \frac{0,4(10) + 1}{1,4 \times 10} = 1,79\,l$$

$$p_3 V_3 = m R T_3 \quad \Leftrightarrow \quad T_3 = 1067\,K$$