

التصحيح المنوذجي لامتحان استرجاع  
 سنة 2021

$$\rightarrow P_1 V_1 = R T_1 \Rightarrow P_1 = \frac{R T_1}{V_1} = 3,32 \times 10^6 \text{ Pa}$$

$$27) \Delta U_{12} = 0, \quad T = \text{cte} \quad \underline{\text{غاز مثالي}}$$

$$\bullet W_{12} = -R T_1 \ln \frac{V_2}{V_1} = -R T_1 \ln 5 = -5,38 \text{ kJ}$$

$$\bullet Q_{12} = -W_{12}$$

$$3) T V^{\gamma-1} = \text{cte} \Rightarrow T_1 V_2^{\gamma-1} = T_3 V_3^{\gamma-1}$$

$$\Rightarrow \bullet V_3 = V_2 \left( \frac{T_1}{T_3} \right)^{\frac{1}{\gamma-1}} = 10,3 \times 10^{-3} \text{ m}^3 = 10,3 \text{ L}$$

$$\bullet P_3 = \frac{R T_3}{V_3} = 242 \times 10^3 \text{ Pa}$$

$$\bullet \Delta U_{23} = C_v \Delta T = C_v (T_3 - T_1)$$

$$c_p - c_v = R, \quad c_p / c_v = \gamma \Rightarrow c_p = \gamma c_v$$

$$\Rightarrow c_v = \frac{R}{\gamma-1} = \frac{5R}{2}$$

$$\bullet \Delta U_{23} = \frac{5}{2} R (T_3 - T_1) = -2108 \text{ kJ}$$

$$\bullet Q_{23} = 0$$

$$\bullet W_{23} = \Delta U_{23} = -2108 \text{ kJ}$$

$$\rightarrow \begin{aligned} T_1 V_2^{\gamma-1} &= T_3 V_3^{\gamma-1} \\ T_1 V_1^{\gamma-1} &= T_3 V_4^{\gamma-1} \end{aligned} \Rightarrow \left( \frac{V_2}{V_1} \right)^{\gamma-1} = \left( \frac{V_3}{V_4} \right)^{\gamma-1}$$

$$\Rightarrow \boxed{V_2 V_4 = V_1 V_3}$$

①

$$5) W_{TOT} = W_{12} + W_{23} + W_{34} + W_{41}$$

$$= -RT_1 \ln V_2/V_1 + C_v(T_3 - T_1) - RT_3 \ln V_4/V_3 + C_v(T_1 - T_3)$$

$$V_4/V_3 = V_1/V_2$$

$$\Rightarrow W_{TOT} = R(T_3 - T_1) \ln V_2/V_1 = -1,34 \text{ kJ}$$

$$6) Q_{TOT} = -W_{TOT} = 1,34 \text{ kJ.}$$

$$7) Q_{12} = 6,15 \text{ kJ} = Q_H$$

$$Q_{34} \approx -RT_3 \ln \frac{V_4}{V_3} < 0 \quad \Rightarrow Q_C$$

$$Q_{34} = Q_C$$

$$8) e = \frac{|W_{TOT}|}{Q_H} = \frac{1,34}{6,15} = 0,22$$

$$e_c = 1 - \frac{T_B}{T_A} = 0,22$$

$$e = e_c$$

السبب أن الحركتين هما حركتين مكافئتين  
وكلتا الحركتين كانتا.